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THE PHILADELPHIA ELECTRICAL EXHIBITION.

FIRST NOTICE.

THIS Exhibition has, at the time we write, been now open about three weeks. As is usual in such matters, there has been delay on the part of some of the exhibitors, and even at present some exhibits are still incomplete, but there is not much cause for dissatisfaction on this head, and we congratulate the management on the very interesting show it has been able to bring together.

It is interesting, especially in the telephonic department—for the history of the telephone is, we think, very completely shown—and it is likewise interesting as illustrating what can be done in electric lighting.

As to novelties, they are but few, and those but of minor import, but we venture to think that so far as America is concerned, the facility with which electricity can be applied to domestic lighting and to the many industrial uses will be brought home to the minds of the visitors and so to the advantage of all concerned.

Those who have seen the exhibitions of Paris, Vienna, and London will find but little they have not seen before. The exhibition consists, moreover, of American manufactures almost wholly, and it must, therefore, be placed in the category of *national* rather than *international* exhibitions, but may not, on that account, be without its special uses.

The customs tariff preventing, as it does, foreign manufacturers from competing with those of the United States in that country, is, of course, one great reason why the European nations are not represented as they otherwise would have been, for we have heard the manufacturers of England say, "We cannot sell our goods there on account of the tariff; why should we go to the expense and trouble of exhibiting?" Another reason may be found in the frequency of such exhibitions. Exhibitors are getting a little tired of such shows, and it will soon be only great international displays which will attract exhibitors at all.

The exhibition hall is a building erected for the occasion, and at night it presents a very brilliant appearance, the arched roof being bountifully supplied with arc lamps (all of one kind in clear glass globes), which shed a profuse light on the exhibits and their surroundings below.

Of course there is the usual fountain, and this is in the centre of the exhibition, and is kept supplied with tinted water, which at night is rendered very effective by the rays, coloured and otherwise, of lamps of Brush or the Thomson-Houston Company.

We shall now give a general account of what is exhibited there, and will in passing state in detail those points which we deem will be more particularly interesting to our regular readers.

Commencing alphabetically we come to the—

Acme Electric and Illuminating Company, of New York, which exhibits an 8 light dynamo, running nine arc lights enclosed. Also two motors, one of 3 H.-P., and one for a sewing machine; incandescence lamps and electric leads.

Alexander Bros., of Philadelphia, show some good-looking specimens of leather belting.

American Bell Telephone Company has a working telephone exchange, connecting 25 exhibitors with the offices of the exhibition and all the subscribers of the Philadelphia Exchange. Facsimiles of the original apparatus of Bell, the *first* telephone (some may not agree to this statement), and the telephones exhibited at the Centennial Exhibition. The original telephones of Edison and Blake, and various telephones and transmitters which have been made and used for commercial purposes, to the number of about 250 kinds.

American Electrical Works, Providence, R. I.—Various kinds of covered wires.

American Numismatic and Archæological Society of New York.—Electrotypes of the finest ancient coins in the British Museum.

American Sectional Underground Company, Philadelphia.—Underground conduits and man-holes, &c.

American Underground Electric Wire Company, New York, exhibit the "Howe" system of insulation, more particularly for underground wires and cables. Apparatus for designating wires, and a conduit system.

American Watchman Time Detector Company, New York, shows an electric indicator for recording the doings of night watchmen. One or more men may record on a single dial the entire work of the night.

Applegate's Electric Alarm Matting Company, Philadelphia, exhibits matting which has contacts placed at short intervals on it, and which is intended to be placed under carpets, so as to give an alarm in cases of burglary. Also an ingenious bell is shown, which we may allude to in another place.

Averill, W. W., Philadelphia.—Another insulating conduit. Conduits are very numerous in the exhibition, and as a general rule are the reverse of practicable inventions.

Batchelden, J. M.—An historic exhibit of various insulators made in 1853, and combined rubber and glass insulators made in 1876.

Bailey, J. S., Buckingham, Pa.—Automatic electric time apparatus, consisting of clocks with improvement and electrical arrangements for dispatching railway trains and for other purposes.

Ball Manufacturing Company, Limited, Reading, Pa., has a show of its now well-known machines, and, we understand, has been doing a brisk business in sales of them during the exhibition. There are the following dynamos:—

One supplies current for five arc lights, and is driven by a 4 H.P. gas-engine; one lights 80 Gatehouse incandescence lamps, and is driven by a 10 H.P. gas-engine; one lights 48 Gatehouse lamps; and, besides these, there are the following specimens not running:—One 65 arc-light dynamo; one combination machine for 10 arc and 80 incandescence lamps; one 17-light machine at 1,650 revolutions with a 1-inch belt, capable of lighting 17 arc lamps; one machine, intended for the comparative tests to be made by the special committee, and which machine, when driven at 800 revolutions, is capable of giving 20 arc lights, and which weighs only 780 lbs. Lamps, &c., complete this exhibit.

Bazerque, L., Paris.—An historical exhibit.

Bernstein Electric Light Manufacturing Company, Boston, Mass.—This company has a room fitted up in the usual way at such exhibitions, and exhibits seventy 40 C.P. incandescence lamps in series. We leave our readers to judge of the advisability of such a system where the E.M.F. must necessarily be considerable, when considered from the point of safety, although for economical reasons it may answer.

Bidwell Electric Railway Company, Philadelphia.—This exhibit consists of a small railway in operation, the current for which is obtained from a Hochhausen dynamo, and is conveyed by means of a brass tube outside the rails, having a slot underneath in which runs a roller connected with the car, and, electrically, to the motor, the return conductor being precisely similar. A motor of a well-known kind, with a Siemens form of armature is fixed under the body of the car. This car will seat about six people, and we may mention that the current supplied not only actuates the motor but lights the car by means of incandescence lamps, and the track is illuminated by it through the medium of arc lamps placed at short intervals along it.

Bonwill, Dr. G. A., Philadelphia, has an historical exhibit of dental-surgical instruments operated by

electricity, including the first electro-magnetic mallet for filling teeth automatically with gold, and seven others showing later improvements. The first dynamo or mechanical mallet superseding the electro-magnetic one. The first dental engine, and three later improvements thereon, also the first surgical engine, stated to be the only one in use ; likewise the first electric and first mechanical pens.

Bowman, C. M., Lebanon, Pa., shows his fire-hose telegraph, which has an electric signal attachment to an ordinary fire-hose, enabling the pipeman to communicate instantly, and at will, with the engineer or plug-man.

Brooks, David, Philadelphia.—The underground telegraph system of this electrician, so well-known on both sides of the Atlantic, has been described in its earlier form and as used on the South Western Railway in our issue of Dec. 1st, 1879, and Aug. 15th, 1881. It has, however, undergone some important changes, the pipes and joints are far neater and less cumbersome, and the oil now used is heavier than water, is cheaper and is a better insulator by ten times than that formerly used. It is called Franklin oil, and comes from Franklin town, Venango county, Pennsylvania.

Brooks' underground telegraph system consists in the use of a liquid insulating medium, in connection with pipes or tubes. Professor Morse, of this country, and Professor Jacobi, of St. Petersburg, Russia, undertook to insulate copper conductors in lead tubes, before any attempt was made to string the conductors upon poles. Every effort to insulate the conductors with rosin, asphaltum, paraffin wax, and similar substances, when placed in lead pipes and buried in the earth or water, is liable to failure, from the fact that coiling and uncoiling the tubes breaks up the insulation, forming innumerable crevices, and these crevices are in the nature of so many faults. The bending of the lead alters the molecular condition of the metal, and makes it sufficiently porous to admit moisture when under the pressure of water or water and air combined. It was the discovery of the cause of repeated failures to maintain the insulation that led to the use of insulating liquids, under pressure. The loss of a few drops of oil is of little or no consequence, but a few drops of water entering the pipes destroy or impair the insulation. By the use of textile coverings, a large number of conductors are grouped in a very narrow longitudinal space. Another advantage is the very low inductive capacity of the insulation, allowing conductors traversed with currents of high potential to be placed in the same tube with telephone conductors, without material disturbance or inconvenience in the use of the telephones.

The conductor brought into this Exposition Building is a number of wires, 22 gauge (Birmingham), placed

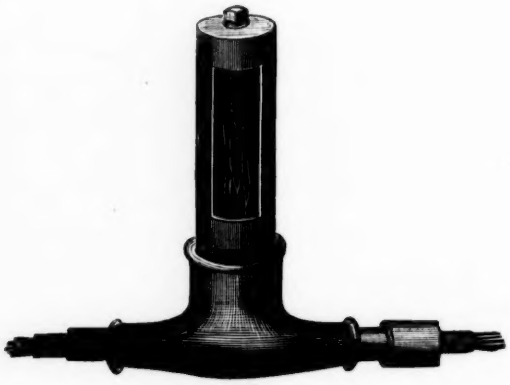


FIG. 1.

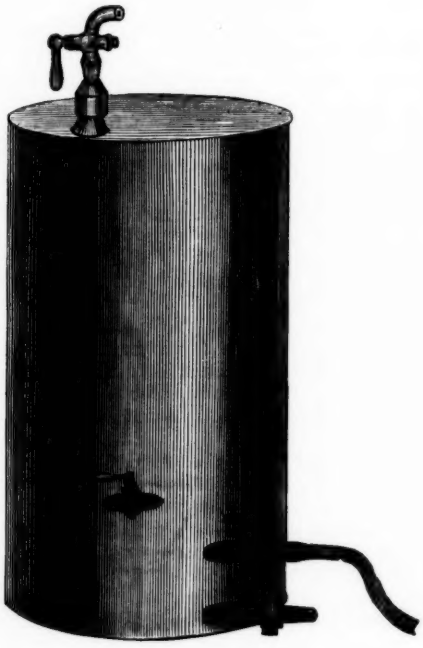


FIG. 3

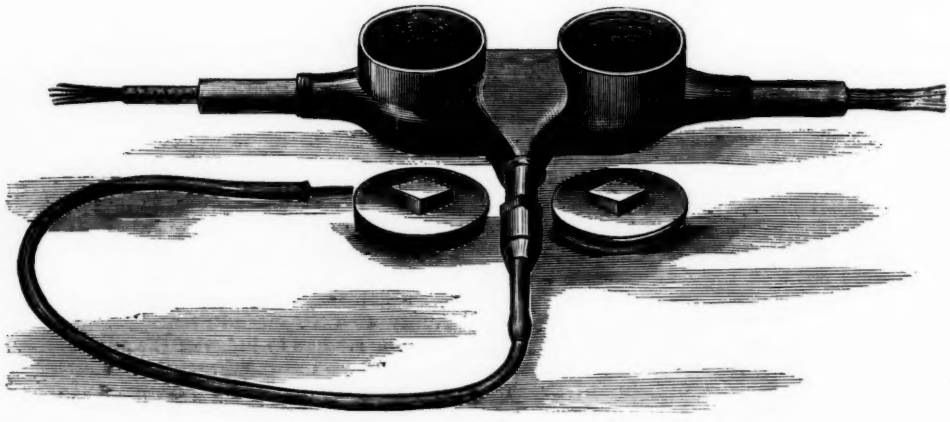


FIG. 2.

underground, eight miles to the Pennyslvania Railroad Station in Kensington. Those interested in underground telegraphy can best examine the system by going into the Pennsylvania Railroad Station, adjoining the Exposition Building, away from the noise and jar in the Exposition Building itself. In this pipe there are 18 Morse circuits and seven telephone circuits in operation. Another feature of the system is its durability. The contents of the tube being hermetically sealed from air, light, and moisture, and protected with a mineral oil, undergo no organic change. The only decay is the outside of the pipe from oxidation. This is prevented by enclosing the pipe in a wood trough of sufficient dimensions to admit the pipe, and filling the remaining space with pitch. There has never been a failure of this system laid by the patentee, although the earliest specimen has been in continued operation for over six years.

No. 1 of this exhibit shows a cable of 400 conductors; 40 of these conductors are No. 16 Birmingham gauge, the remaining 360 are No. 20 Birmingham gauge. The cost of laying this cable in a two-and-a-half inch diameter pipe, enclosed in the wood trough, filled with pitch, with outlets and hand-holes sufficient to bring or loop conductors to every building in the adjoining blocks, opening, closing and repaving the streets, does not exceed 20 dollars per mile per conductor, all told. There are not 300 conductors upon telegraph poles in any street in this city; the most in any street is in Third Street, between Market and Chestnut Streets. On the two sets of poles there are 220 wires at this date. On the east side of Third Street, between Chestnut and Walnut Streets, there are under ground 343 conductors, in good electrical condition, all laid in a day, and the street repaved, between the hours of 7 o'clock in the morning and 6 in the evening. During the same length of time 2,000 feet were laid on North Front Street.

Fig. 1 shows the method of making splices.

Fig. 2 shows the hand-holes and outlets for taking wires into adjoining buildings.

Fig. 3 shows the tank at the Broad Street Station, supplying the system with pressure and oil lost by leakage, which is scarcely perceptible.

Bruce, E. M. & Co., show an Estey organ run by a Cleveland motor.

Brush Electric Company, Cleveland. — This company has one 60-arc light dynamo, lighting 64 2,000-C.P. lamps; it is driven by a 45 H.P. Buckeye engine. This machine is said to run at 810 revolutions, and to develop greater electrical power than any other machine in the building. At 830 revolutions it is stated to be capable of supplying 70 lamps of the power above-mentioned. Two E 6 compound shunt-wound machines for 150 lamps each, at 1,205 revolutions, requiring 15 H.P., are capable of supplying 168 incandescence lamps of 20 C.P. This dynamo is wholly automatic in its regulation, it being possible to turn off all but one of the lamps, the dynamo automatically regulating itself promptly. It is wound in a similar way to the Victoria dynamo of the English Brush Company, but adapted to the Brush machine. The coarse and fine wire coils are, however, placed side by side (the coarse nearest the pole), and not superposed. Two 40-light storage batteries of Brush pattern, of 21 cells each, are shown. The cells measure $16 \times 18 \times 3$ inches. Each battery is capable of running 40 lights for five hours, or one light for 200 hours.

The reporters' room is illuminated by means of one of these batteries, as is also the Cleveland motor exhibit. A plating machine in operation and run by a "Brush" motor, and about 20 different forms of arc lamps are also part of this company's display. The fountain is illuminated by it with a 4,000 C.P. focussing lamp, and the search lamp on the tower of the building is part of this exhibit. A 15-light dynamo (of 4,000 C.P. per lamp) is used for the day exhibits and also for charging at the same time the secondary batteries. The automatic regulator of Brush is also a prominent feature. It is apparently somewhat similar to apparatus which have already been used in England, and the resistance portion of the instrument is formed of blocks or squares of carbon.

The armature of an electro-magnet which is in the main circuit actuates a lever to which it is attached, and thus more or less pressure is brought to bear upon the carbon squares. These carbon resistances are placed in the field-magnet circuit of the machine and regulate the intensity of the magnetic-field.

These enterprising exhibitors illuminate several rooms fitted up, one as a bed room, one as a drawing room, and one is designed to illustrate the effect of the incandescence light in loom work; the looms are, by the way, run by a Brush electro-motor.

We notice also a display here of carbons manufactured for the English navy, and consisting of carbons 24 inches long and $2\frac{1}{2}$ inches diameter, intended for use with 100,000 C.P. lamps.

We may mention that all the incandescence lamps of this exhibit are of Swan pattern, the Swan and Brush patents being in the United States owned by the same company. These lamps were giving a very white light; the design of the fittings were more chaste than is usual, and it is altogether a very practical and sensible exhibit.

The engines used here by this company are of various makes, such as Buckeye, Porter-Allen, Westinghouse, Ball (of Erie), and Straight-line, designed by Prof. Sweet, of Syracuse.

Chicago Insulating Company exhibits some Fiske and Mott insulators, insulating knobs, hooks, &c.

Clay Commercial Telephone Company of Philadelphia has several sets of telephonic instruments, such as were described in our issue of August 2nd, 1884, and a section of a "Clay" telephone switch board. Also the "Clay" exchange system, illustrated and described in the above-mentioned is shown.

Cleveland Motor Company, Philadelphia, has an exhibit of its special form of motor.

College of New Jersey, Princeton, N. J., has an historical exhibit, consisting of the coils used by Prof. Joseph Henry at Princeton in investigating the laws which govern the production of an extra current, which appears upon breaking a battery circuit. These were also used in studying the laws of induced currents, 1832-38. The magneto engine constructed by Prof. Henry, 1831-32. Electro-magnets. His great magnet, which supported 3,300 pounds. A portion of the Professor's battery, constructed 1834, and pole changers, and a galvanometer invented and used respectively by him.

Continental Underground Cable Company. — The company owns two separate and distinct systems, protected by several letters patent, and similar to that described in the ELECTRICAL REVIEW for August 25th, 1883. The feature of this system is the railway and the electric car with its adjustable arms to facilitate the laying of the cables by depositing a cord or fine chain in the pockets desired; the cord or fine chain being used to draw the cables into position. The pockets are arranged to communicate, yet separate and independent of each other, so that each company may have separate apartments. The cables are introduced or drawn out without disturbing the street.

Cosmopolitan Underground Telegraph, Telephone and Electric Light Company, of Camden, N. J.— This company has a complete system for laying telephone, telegraph and electric light wires and operating the same underground. The conduit proper is composed of quarter sections of terra cotta placed over a bed or baseplate of the same material as a foundation. The interior of the conduits has at suitable distances from each other iron frames which clamp large plates of some suitable insulating material. These plates are perforated with holes of various sizes suited to the gauge of wire to be used. The wires are in these holes, the terminals being fastened by a suitable device at each end of a conduit section, man-holes being placed wherever necessary along the route of the conduit. This system places the wires in a perfectly air-tight chamber, from which moisture and dust, two elements which are destructive to wires and their insulation, is excluded.

Crampton, Thomas Russel, London, England, exhibits a section of the first cable laid between Dover and Calais.

Cumming and Brinkerhoff, New York, show electrodes for electric telegraphs and the Cumming periphery disc.

Cushing, F. W., New York City, exhibits his velocimeter, a device for measuring and recording the velocity of projectiles or other moving bodies. A tuning fork vibrating at a known rate, say 100 times per second, is made to record each vibration upon chemically prepared paper, and the projectile in its flight is made to break two fine wires situated a known distance apart. The time elapsing between the breaks is recorded.

Day, Austin G., New York, exhibits various specimens of his conductors, insulated with his special kerite insulation.

Dolbear, Amos E., Boston, has a full exhibit of his various telephone receivers and transmitters, and also models of those of Reis and Yeates (of Dublin), an ampèremeter, gyrostat, &c.

Dowdell, A. W., Philadelphia, shows fancy woodturning operated by electricity.

Dudley, P. H., New York, exhibits a dynagraph and track inspection car, to be contained in a special car constructed for its use. Electricity is used to record the distance run by the car, the ratios of work, and mile-posts, &c.

Edison exhibits.—The exhibits which first attract attention on entering the building are those of Edison and of the various companies formed to work his inventions in the United States. Thus there are combined in one great exhibit the Edison private exhibit; that of the Edison Machine Works Company, of Goercke Street, New York; of the Edison Tube Works Company, of Brooklyn; of the Edison Lamp Company, of East Newark, N. J. (which factory we understand covers an area of 2½ acres, and can turn out 5,400 lamps daily); of the Edison Illuminating Company, of New York, for central station lighting; and of the Edison Company, for isolated lighting; also that of Messrs. Bergman & Co., in which company Mr. Edison is largely interested, and which manufactures the ornamental fittings and fixtures for the Edison light. This firm also has made a special feature of switches, resistance coils, galvanometers, Wheatstone bridge sets, and all testing and other electrical instruments made under Edison's patents and otherwise.

The Edison private exhibit consists of specimens of the numerous instruments of his invention, most, if not all, of which were exhibited at the Paris and London Exhibitions. There is, however, one experiment* shown here sometimes to scientists by Edison himself. It is this—a lamp of the usual pattern, with the addition of a strip of platinum foil stationed between the two arms of the carbon, looped and connected electrically with the outside in usual way, is joined up with a galvanometer and a dynamo circuit thus:—C, carbon filament; P, platinum strip, connected only to one side of the galvanometer, G (see fig. 4).

When the current passes through the loop, and the positive pole is connected to the galvanometer, a very considerable deflection is obtained thereon, although there is no circuit, but scarce any deflection is obtained when the negative pole is substituted for it. And we were informed that if foil were placed properly over the enclosing bulb and the galvanometer wire attached thereto, instead of to the carbon filament, a similar result was obtained.

Edison Illuminating Company has in action two S machines, running at 1,200 revolutions, lighting each 200 incandescence lamps; two Y machines, running at 1,200 revolutions, lighting each 300 incandescence lamps; two H machines, running at 1,100 revolutions, lighting each 400 incandescence lamps; one combined steam engine and dynamo, running at 350 revolutions for lighting 1,500 incandescence lamps.†

* See Edison's specification, No. 2988, in last week's REVIEW.

† Running about 1,000 lamps.

The two H and two S machines are working the three-wire system, whilst the remaining machines work the two-wire system. Two machines are driven by engines of Armington and Sims' manufacture, the two H machines by engines of Porter and Allen, one by a Southwark (Philadelphia) engine, and one by an engine of the New York Safety Steam Power Company's manufacture.

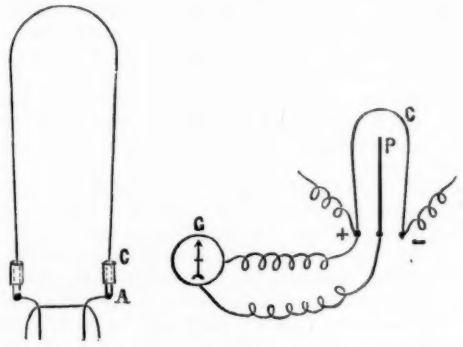


FIG. 4.

Edison Machine Works Company has a set of Edison machines, not in action, constructed for 25, 50, 100, 200, 300, and 400 lights, and a disc dynamo, which we are informed was made in Edison's laboratory in the year 1879.

Before passing from the machines it may be as well to remark that the recent improvements effected in them may be summarised as follows—Shortening of the field-magnets and lengthening of the armature with an increase of iron therein. The construction of machines to run at a slower speed, and improvements in the switches and brush-holders.

The Edison Lamp Company has a large display of lamps, one recent improvement in which consists in the method of clamping the carbon. A folded flattened copper strip is soldered straight on to the platinum wires at the outside of the fold, as at A, a collar, C, of copper having first been placed over the doubled slip, the carbon is then inserted and the collar drawn up (see fig. 4).

There are placed on a tower in this exhibit 2,700 of these lamps, arranged spirally in rows of white, red, yellow, blue, and purple, so as to produce varied effects at will.

Altogether the Edison exhibits are numerous, good of their kind, and make an important feature in the collection.

Electric Manufacturing Company of Troy exhibits galvanometers, resistance coils, &c., &c., of the usual patterns.

Electrical Supply Company of New York has a very considerable assortment of instruments of English manufacture, including some of Elliott Bros., Ayrton and Perry, K. Hedges, and Woodhouse and Rawson; also wire by F. Smith & Co., of Halifax, England, Callender & Co., and by the Clark Insulated Wire Company, as well as wires of their own manufacture, and a collection of Wallace "diamond" carbons.

"*Electrical World*."—Our contemporary, with its usual energy, has during the exhibition printed its issues in the exhibition building, obtaining the power by the medium of a Daft motor, from one of the dynamos stationed some distance away in another part of the building. The printing is also accomplished from electrotyped reproductions, and not from the type itself.

Electro-Dynamic Company, Philadelphia exhibits motors, batteries, &c., of the now well-known patterns of Griscom, also some dynamos, we believe, likewise of his design.

Excelsior Electric Company, New York, has a small exhibit of dynamos of the Arnoux-Hochhausen pattern, with arc lamps, &c.

Franklin Institute.—Historical exhibit of Saxon's magneto-electric machine, Hare's lightning rods, and Franklin's electric machine.

Garnett, James, Philadelphia.—Belting.

Gillinder and Sons, Philadelphia.—Electric light globes.

Globe Telephone Company's (New York) exhibit is one that at present attracts (amongst telephone men) considerable notice. This company was formed to work the Shaw patents, and now controls as well the Hadden inventions, which are, for the present, kept entirely secret; we cannot, therefore, describe them. But it is in the Meucci invention shown here that the greatest interest lies, and of this we shall now give some information additional to that already given on this matter in our columns at various times, first premising that litigation is pending between this company and the American Bell Telephone Company, and that the documents to which we shall allude are in part those prepared for this litigation. There are some others which carry, we understand, the circumstantial evidence still further, but it will be easily understood that our position is one of some delicacy, seeing that whilst it is our desire to convey early information on these matters, we are in honour bound not to disclose the contents of papers to which we may have access, to the injury or inconvenience of the company conceding us such advantages. Also it will be understood we express no opinion of our own on a case which has, perhaps in the near future, to be argued and decided before a Court of the United States.

The documents above alluded to are as follows:—

The affidavit of Antonio Meucci, of Clifton, Staten Island, is to the effect that he believes he is the original and first inventor of a system of telegraphing by sound, and that he made the discovery in Havanna on the island of Cuba, in 1849. That he continued to experiment in the years 1852-3, &c., and also in Staten Island and that in 1860 he deputed his friend, Mr. Henry Bendelarri, then of New York, and now of Toronto, who was going to Europe to interest proper persons in his invention. That in 1871 he filed a caveat in the United States patent office, and renewed the said caveat as long as he could spare the money therefor. In 1872 he states that in company of his friend, A. Bertolino, of New York, he tried to interest Mr. Grant, then President of the New York District Telegraph Company and frequently repeated his claim as the said original inventor to the public press, a repetition of which was published in New York City, on March 6th, 1880. Further he makes oath that, owing to injury received by him in the explosion upon the Staten Island ferry-boat, the *Westfield*, and the resulting ill-health, loss of time, money and business, he has been totally unable to pay for the necessary models, drawings, attorney's fees, &c., to complete his applications for patents for his telephone. This affidavit is dated March 20th, 1880.

The affidavit of Angelo Bertolino, of New York City (above mentioned), is to the effect that in 1871 he had to draw some papers concerning Meucci's invention and system for the transmission of the human voice by electric wires called the telephone. That in 1872, by means of his interpretation, Mr. Meucci explained his invention to Mr. Grant, and requested him to try some experiments by the wires of his company. That they handed Mr. Grant an outlined description in the English language of the invention, together with a copy of the caveat (mentioned in affidavit of Meucci). That Mr. Grant promised that at first opportunity he would try his experiment; then recounts various delays, until, after two years, Mr. Meucci despaired of Mr. Grant's assistance, and at Mr. Meucci's request he called on Mr. Grant to obtain the said papers, and that Mr. Grant stated that they had been loaned, and that neither he nor Meucci have ever obtained them back. It also corroborates Mr. Meucci's affidavit as to the result to the inventor's health and means, and as to the explosion upon the ferry-boat.

The affidavit of Esterre Meucci, the wife of the inventor, states that in Havanna Meucci, whilst engaged as director of the mechanism at the Town Opera House, sometimes devoted his attention to making various articles of galvano-plastic, and made experiments endeavouring to speak to another person at some distance through "the use of the wire attached to his electric battery." That "the persons with whom he made experiments, as well as myself, heard words through a wire, but not satisfactorily plain to my husband." Mentions the burden she has been, on account of incurable rheumatism, to him, and she corroborates Mr. Bendelari's statement about his being asked, in 1860, to interest capitalists in Europe. It then touches on the subject of the explosion, and states the amount of their indebtedness for the necessaries of life, and for the expenses of sickness. It goes on to relate that when Meucci had somewhat recovered from his injuries he recommenced his experiments, and borrowed money for drawing the necessary papers in English language (he being not familiar therewith), and that he filed his caveat. Mentions the Grant matter, and then deposes that she sold some of Meucci's devices to a second-hand dealer of Clifton (one John Fleming) to get money to support themselves, and corroborates her husband's affidavit.

The affidavit of Mathias Egloff, of Clifton, Staten Island, states that he assisted Meucci in several works of his invention, &c., and that about the years 1860 or 1861 Meucci told him his experiments were made in order to enable him to succeed in the transmission of the human voice by the electric wires. Touches on the period after the explosion, and states that the apparatus he has seen in Mr. Meucci's home are the same in kind, shape and material as those used and seen by him in 1859-60 and 1861.

The affidavit of Samuel Lewis, of Clifton, poormaster, testifies to Meucci's poverty in 1880.

The affidavit of W. Bowen, of Clifton, testifies to Meucci's poverty in 1878 and 1879, and that the County gave him $25 per year, as shown by the account books.

The affidavit of Henry King, of Stapleton, testifies to Meucci's injuries by the explosion, and that he attended him as physician, and alludes to his poor condition, financially and physically.

The affidavit of John Fleming corroborates that of Meucci's wife as to the sale of the devices, and speaks as to the shape; says they would have filled a barrel, and that he sought in his old stock for some without success.

The affidavit of Nestore Corradi, of New York, an artist by profession, states that about 1857 and 1858 he drew for Meucci a sketch, and that on that occasion Meucci told him it represented "one of the two persons he had to operate at each end of the electric wire of a transmission of a long distance of the human voice," and that Meucci told him he had invented it and called it a telephone.

The affidavit of Luigi Tartarini, of New York, who knew Meucci in Havanna, and also in New York, states that in 1849 he saw him making experiments to transmit "the human voice by electric wires," and goes on to say that he saw the experiments continued in Clifton in 1857 and 1858. Alludes to the explosion and also says that instruments recently seen in the hands of Meucci are of the same kind and description as those seen by him in Staten Island in 1852-53-57 and 1859, and speaks of the inventor's poverty.

The affidavit of Reuben Lord, of Clifton, testifies as to Meucci's poverty.

The affidavit of Henrico Bendelari testifies to the correctness of the statements respecting his trip to Europe, and as to his having seen in 1860 what is now known as a telephone, and intended to enable persons to speak at a distance from one another, and as to his being asked to organise a company, or obtain the necessary assistance.

The affidavit of Guiseppe Gregori testifies as to narrow circumstances of inventor.

The affidavit of Antonio Luzari is to the same effect.

The affidavit of Patrick Kehoe, of Clifton, who heard Meucci say that he was making instruments in order to

succeed in the transmission of the human voice, and that was about the years 1861 or 1862, and heard through Meucci's wires the sound of his voice without distinguishing the words, and that said wires were connected with galvanic batteries.

The affidavit of John Lidell, agent of the late Charles

FIG. 5.—MEUCCI'S TELEPHONE SAID TO HAVE BEEN MADE IN THE YEAR 1857.

Chester, of New York, testifies to the following entries in the books of the said Charles Chester.

"To Antonio Meucci, of Clifton Brewery, Staten Island, August 10, 1858, seven pairs magnets on one base, $50.—Paid August 2, 1858."

"To Antonio Meucci, of Clifton Brewery, Staten Island, August 14, 1858, twelve cells Grove battery, $1·50, $18. To altering magnets and making new cores, $42 (total $60).—Paid August 20, 1858."

informed in 1858, by Meucci, that he was the first inventor of the telephone, which fact was published 1859. File of papers since destroyed.

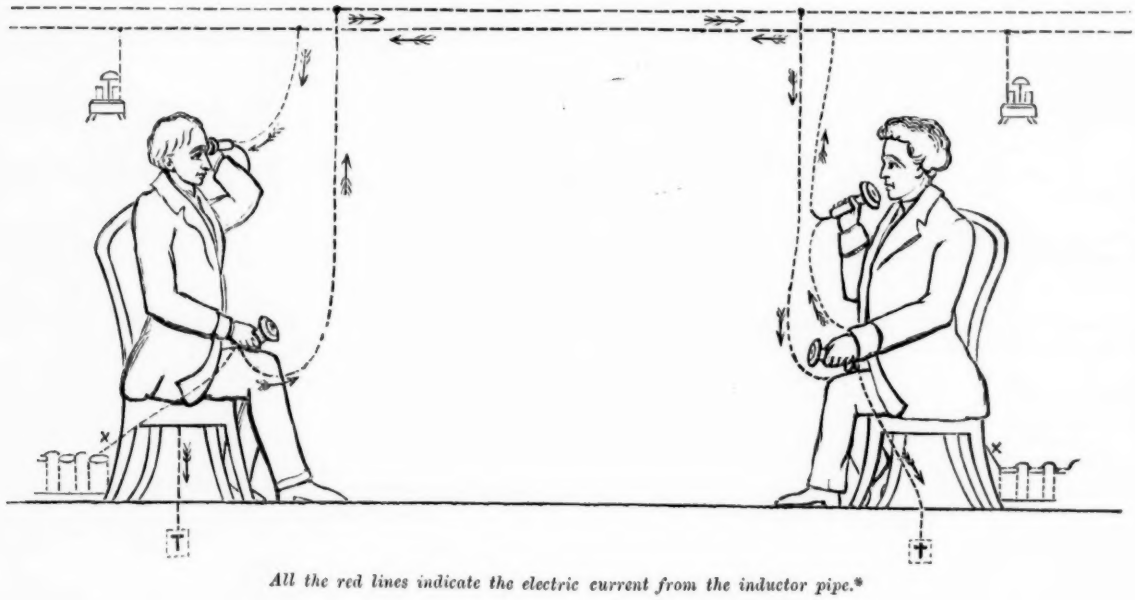
The affidavit of Ferdinand de Luca, formerly Italian Consul-General in the City of New York from the year 1867 to 1878, and at present (July, 1880) Minister Resident of Italy in China, is to the effect that he knew Meucci, and that he knew him to be the inventor of several discoveries, and that it is within his knowledge that the said Meucci, many years previous to his going to New York, and during his residence was "making experiments to succeed in the transmission of human voice by electric wires—what is now called telephone." Also speaks as to his poverty, and the assistance rendered by himself and other Italian gentlemen.

The affidavit of Angelo Bertolino (before mentioned) relates to a coversation with the aforesaid Mr. Grant.

The affidavit of L. D. Cunningham, of New York, states that he knew Meucci for many years, and in 1877 went to New York to live, and took Meucci's papers for the purpose of introducing the subject to scientific gentlemen, among them Professor Parmelee. That he did this because an exhibition had been given at Steinway Hall about September, 1877. Professor Parmelee having seen the caveat and descriptions, expressed surprise at what he found in the papers, and said: "If this be true Meucci has the first claim," or words to that effect, and mentions the aforesaid Stetson, the one who took out the original caveat, about 1876, as being with Bell, Gray & Co.

Having now given what we think the most interesting parts of the above affidavits we will conclude our notice of this exhibit by giving a drawing of one of Meucci's telephones exhibited here, together with a copy of the caveat filed in 1871, and a reproduction of

FIG. 6.—LINE OF SEVERAL MILES.



*All the red lines indicate the electric current from the inductor pipe.**

The affidavit of Gaetano Negretti states that in 1844 he went to Havanna and had there some galvanic batteries purchased from his late brother Henry Negretti, of Negretti and Zambra, of London, and sold them with some other instruments of electricity to Mr. Antonio Meucci, and afterwards in New York, in 1851, bought for him other implements for the same object.

The affidavit of E. F. Secchi de Casili, of New York, states that he is the editor of the semi-weekly newspaper the *Echo of Italy*, published in New York, was

the drawing said to be the original one on which the caveat was based. Fig. 5 represents a concave mouthpiece on a tube, A, into which tube the cup, B, fits; through the centre of cup, B, an electro-magnet is inserted by means of the screw, S. The diaphragm indicated by dotted lines, as at D, is made, we are informed, of a substance capable of induction, and the line, O, represents the orifice just above it.

Fig. 6 is the copy of the aforesaid drawing.

* For red lines see dotted lines in reproduction.—EDS. ELEC. REV.

"*Specification*—The following is a description of the invention sufficiently in detail for the purposes of this caveat :—

"I employ the well-known conducting effect of continuous metallic conductors as a medium for sound, and increase the effect by electrically insulating both the conductor and the parties who are communicating. It forms a speaking telegraph without the necessity for any hollow tube. I claim that a portion or the whole of the effect may also be realised by a corresponding arrangement with a metallic tube.

"I believe that some metals will serve better than others, but propose to try all kinds of metals.

"The system on which I propose to operate and calculated, consists in isolating two persons separated at considerable distances from each other by placing them upon glass insulators, employing glass, for example, at the feet of the chair or bench on which each one sits, and putting them in communication by means of a telegraphic wire. I believe it preferable to have the wire of larger area than that ordinarily employed in the electric telegraph, but will experiment on this. Each of these persons holds to his mouth an instrument analagous to a speaking trumpet, in which the words may be easily pronounced and the sound concentrated upon the wire. Another instrument is also applied to the ears to receive the voice of the opposite party.

"All these, to wit the mouth utensil and the ear instruments, communicate to the wire at a short distance from the persons. The ear utensils, being of a convex form, like a clock glass, enclose the whole exterior part of the ear, and make it easy and comfortable for the operator. The object is to bring distinctly to the hearing the words of the person at the opposite end of the telegraph.

"To call attention, the party at the other end of the line may be warned by an electric telegraph signal or a series of them. The apparatus for this purpose and the skill in operating it need be much less than for the ordinary telegraphing.

"When my sound telegraph is in operation the parties should remain alone in their respective rooms, and every practicable precaution should be taken to have the surroundings perfectly quiet.

"The closed mouth utensil or trumpet and the enclosing the persons also in a room alone both tend to prevent undue publicity to the communication. I think it will be easy by these means to prevent the communication being understood by any but the proper persons.

"It may be found practicable to work with the person sending the message insulated and with the person receiving it in a free electrical communication with the ground. Or these conditions may possibly be reversed and still operate with some success. Both the conductors or utensils for mouth and ears should be—in fact, I may say, must be—metallic, and be so conditioned as to be good conductors of electricity.

"I claim as my invention and desire to have considered as such for all the purposes of this caveat

"The new invention herein set forth in all its details, combinations and sub-combinations.

"And, more specifically, I claim—

"*First.* A continuous sound conductor electrically insulated.

"*Second.* The same adapted for telegraphing by sound or for conversation between distant parties electrically insulated.

"*Third.* The employment of a sound conductor which is also an electrical conductor as a means of communication by sound between distant points.

"*Fourth.* The same in combination with provisions for electrically insulating the sending and receiving parties.

"*Fifth.* The mouth-piece or speaking utensil in combination with an electrically insulating conductor.

"*Sixth.* The ear utensils or receiving vessels adapted to apply upon the ears in combination with an electrically insulating sound conductor.

"*Seventh.* The entire system comprising the electrical and sound conductor insulated and furnished with a mouth-piece and ear-pieces at each end adapted to serve as specified.

"In testimony whereof I have hereunto set my name in presence of two subscribing witnesses.

"ANTONIO MEUCCI.

"*Witnesses*—

"Shirley McAndrew.

"Fred'k Harper."

"1871. *Caveat* No. 3335. Antonio Meucci, of Clifton, County of Richmond, State of New York. 'Sound Telegraphs.' Rec'd Dec. 28th, 1871; Petition, Dec. 28th, 1871; Affidavit, Dec. 28th, 1871; Specification, Dec. 28th, 1871. Cash $10. Ex'd, H. M. N., E. A. M."

WHAT IS ELECTRICITY?*

ALL Professor Trowbridge hoped to do was to make his audience ask themselves the question with more humility and a greater consciousness of ignorance. We shall probably never know what electricity is, any more than we shall know what energy is. What we shall be able, probably, to discover, is the relationship between electricity, magnetism, light, heat, gravitation, and the attracting force which manifests itself in chemical changes. Fifty years ago scientific men attached a force to every phenomenon of nature: thus there were the forces of electricity and magnetism, the vital forces, and the chemical forces. Now we have become so far unitarian in our scientific views, that we accept treatises on mechanics which have the one word "Dynamik" for a title; and we look for a treatise on physics which shall be entitled "Mechanical Philosophy," in which all the phenomena of radiant energy, together with the phenomena of energy which we entitle electricity and magnetism, shall be discussed from the point of view of mechanics. What we are to have in the future is a treatise which will show the mechanical relation of gravitation, of so-called chemical attracting force, and electrical attracting force, and the manifestations of what we call radiant energy. We have reduced our knowledge of electricity and magnetism to what may be called a mechanical system, so that in a large number of cases we can calculate beforehand what will take place, and we are under no necessity of trying actual experiments. It is probable, for instance, that the correct form of a dynamo-machine for providing the electric light can be calculated and the plans drawn with as much certainty as the diagrams of a steam-engine are constructed. We may congratulate ourselves, therefore, in having a large amount of systematic knowledge in electricity; and we see clearly how to increase this systematic knowledge; for we have discovered that a man cannot expect to master the subject of electricity who has not made himself familiar with thermo-dynamics, with analytical mechanics, and with all the topics now embraced under the comprehensive title of "physics."

Out of all the theories of electricity, the two-fluid theories, the one-fluid, or Franklin theory, and the various molecular theories, not one remains to-day under the guidance of which we are ready to march onward. We have discovered that we cannot speak of the velocity of electricity. All that we can truly say is, we have a healthy distrust of our theories, and an abiding faith in the doctrine of the conservation of energy.

It is one thing to become familiar with all the applications of the mechanical theory of electricity, and another to make an advance in the subject so that we can see the relations of electrical and magnetic attraction to the attraction of gravitation and to what we call chemical attraction. To this possible relationship, Professor Trowbridge wished to call attention. The

* Abstract of an address before the section of physics of the American Association for the Advancement of Science, at Philadelphia, September 4th, by Prof. John Trowbridge of Harvard College, Cambridge, vice-president of the section.

new advances in our knowledge of electrical manifestations are to come from the true conception of the universality of electrical manifestations, and from the advance in the study of molecular physics. When we let an acid fall from the surface of a metal, the metal takes one state of electrification and the drop of acid the other; in other words, we produce a difference of electrical potential. On the other hand, a difference of electrical potential modifies the aggregation of molecules. The experiments of Lippman are well known. He has constructed an electrometer and even a dynamo-electric machine which depend upon the principle that the superficial energy of a surface of mercury covered with acidulated water is modified when a difference of electrical potential is produced at the limiting surfaces. The manifestations of what is called superficial energy—that is, the energy manifested at the surface of separation of any two substances—and the effect of electricity upon the superficial energy, afford much food for thought. There have always been two parties in electricity—one which maintains that electricity is due to the contact of dissimilar substances, and the other party which believes that the source of electrical action must be sought in chemical action. Thus, according to one party, the action of an ordinary voltaic cell is due to the contact, for instance, of zinc with copper; the acid or solution of the cell merely acting as the connecting link between the two. According to the other party, it is to the difference of the chemical action of the metals on the connecting liquid, that we must attribute the rise and continuance of the electrical current. The electromotive force of a voltaic cell is undoubtedly due to the intrinsic superficial manifestation of energy when two dissimilar metals are placed in connection with each other either directly or through the medium of a conducting liquid. The chemical action of the liquid brings new surfaces of the metals constantly in contact; moreover, we have the difference of superficial energy between the liquid and the metals, so that our expression for electromotive force is far from being a simple one: it contains the sum of several modifications of superficial energy at the surfaces of the two metals and at the two boundaries of the liquid and the metals.

We have again a development of electromotive force by the mere contact of the metals at different temperatures. The electrical current that arises is due to the difference of superficial energy manifested at the surface of the two junctions. We know that the action is on the surface, for the size of the junctions does not affect the electromotive force. Suppose that we should make the metals so thin that an ultimate molecule of iron should rest against an ultimate molecule of copper, should we not arrive at a limit, at a definite temperature of the conversion of molecular vibration into electrical energy? And also, when our theory is perfected of the number of molecules along a linear line of copper against a linear line of zinc which can produce a current of electricity of a given strength—the jostling, so to speak, of these ultimate molecules of two metals at different temperatures might form a scientific unit of electromotive force in the future science of physical chemistry. By means of an alloy we can apparently modify the superficial energy at the surface of a solid. Thus an alloy with a parent metal will give a varying electromotive force. If we could be sure that an alloy was always of a definite chemical composition, and not a more or less mechanical admixture, it seems as if we could get closer to the seat of electromotive force by a number of quantitative measurements. Unfortunately, the physical nature of alloys is not definitely known, and there is little coherence or regularity in our measurements of their electromotive force. We can modify the superficial energy of metals, not only by melting metals together, but also by grinding them to a very fine powder, and compressing them again by powerful means into solids more or less elastic, and then examining their superficial energy which is manifested as electromotive force. Professor Trowbridge is still engaged upon researches of this nature; and, if the work is not brilliant, he hopes that it will result in the accumulation of data for future generalisation.

The subject of thermo-electricity has been eclipsed by the magnificent development of the dynamo-electric machines; but we may return to thermo-electricity as a practical source of electricity. Professor Trowbridge has been lately occupied in endeavouring to modify the difference of potential of thermo-electric junctions by raising one junction to a very high temperature under great pressure; for it is well known that the melting point of metals is raised by great pressure. If the metal still remains in the solid state under great temperature and great pressure, can we not greatly increase the electromotive force which results from the difference of superficial energy manifested at the two junctions?

It is evident that our knowledge of electricity will increase with our knowledge of molecular action, and our knowledge of molecular action with that which we call attractive force. It is somewhat strange, that, although we are so curious in regard to electricity, we seldom reflect that gravitation is as great a mystery as electrical attraction. What is the relation between electricity and magnetism and gravitation and what we call the chemical force of attraction?

The question of the connection between electricity and gravitation dwelt much in Faraday's thoughts. He failed, however, to find the slightest relation between gravitation and electricity; and he closes his account of his experiments with these words: "Here end my experiments on this subject for the present, but I feel the conviction that there must be some connection between electricity and gravitation." Was the direction in which he experimented the true direction to look for a possible relation? and cannot the refined instruments and methods of the electrical science of the present aid us in more promising lines of research? If we could prove that whenever we disturb the relative position of bodies, or break up the state of aggregation of particles, we create difference of electrical potential; and, moreover, if we could discover that the work that this electrical potential can perform, together with the heat that it developed by the process, is the complete work that is done on the system against attractive force—or as so-called chemical attractive force—we should greatly extend our vision of the relation of natural phenomena. And thus pursuing the line of argument of his address, Professor Trowbridge ventured to state an hypothetical law which it seemed to him is at least plausible: That "whenever the force of attraction between masses or molecules is modified in any way, a difference of electrical potential results." Is it not reasonable to suppose that certain anomalies which we now find in the determinations of specific heats of complicated aggregation of molecules are due to our failure to estimate the electrical equivalent of the movements and interchanges of the molecules? Let us take the case of friction between two pieces of wood: is it not possible that the friction is the electrical attraction which results from the endeavour to connect the phenomenon of superficial energy with electrical manifestations, that the friction between two surfaces is modified by keeping these surfaces at a difference of electrical potential? In Edison's motophone, we see this exemplified in a very striking manner.

Professor Trowbridge's own studies have been chiefly in the direction of thermo-electricity and in the subject of the electrical aspect of what we call superficial energy. These experiments so far deepen the belief that any change in the state of aggregation of particles—in other words, any change which results in a modification of attracting force—whether gravitative or the commonly called chemical attracting forces, results in an electrical potential; and conversely, that the passage of electricity through any medium produces a change of aggregation of the molecules and atoms. If we suppose that radiant energy is electro-magnetic, cannot we suppose that it is absorbed more readily by some bodies than by others, or, in other words, that its energy is transferred, so that with the proper sense we would perceive what might be called electrical colour, or, in other

words, have an evidence of transformations of radiant energy other than that which appeals to us as light and colour? We have arrived at the point in our study of electricity where our instruments are too coarse to enable us to extend our investigations. Is not the physicist of the future to have instruments delicate enough to measure the heat equivalent of the red and the yellow and the blue violet rays of energy? instruments delicate enough to discover beats of light as we now discover those of sound? The photographer of to-day speaks in common language of handicapping molecules by mixing gums with his bromide of silver, in order that their rate of vibration may be affected by the long waves of energy. Shall we not have the means of obtaining the mechanical equivalent of such handicapped vibrations? We have advanced; but we have not answered the question which filled the mind of Franklin, and which fills men's minds to-day: What is electricity?

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—MONTREAL, 1884.

(*Continued from page* 263.)

RECENT IMPROVEMENT IN APPARATUS AND METHODS FOR SOUNDING OCEAN DEPTHS.

By Rear-Admiral DANIEL AMMEN, U.S. Navy.

THE intended laying of the Atlantic telegraph cable some thirty years ago, awakened a general as well as a specific interest in relation to the depths of the sea, and in gaining a knowledge of them. Fair results were then obtained by Lieutenant Berryman and others, considering the imperfect appliances known at that time, to sound the relatively small depths of the North Atlantic. Shortly after, the simple and effective device of Lieutenant Brooke, U.S.N., for detaching the sinker, was in use; and also the cup of the late Rear-Admiral B. F. Sands, for securing specimens of the bottom. Able and thoughtful men were these pioneers in sounding the depths of the sea, and substantial results came from their labours, but owing to imperfections of one part or another of the means employed, the operation of sounding was painfully slow, only approximately correct, and at times grave doubts existed as to some of the actual depths obtained.

In the autumn of 1871 scientists and the public were informed of the success of Sir William Thomson in sounding in a depth of 2,700 fathoms in the Bay of Biscay. He used pianoforte wire, Birmingham gauge 22, weighing 14½ lbs. to the nautical mile, capable of bearing a strain of 230 lbs. His dynamometer, had three miles in length of this wire been wound upon the drum, would have been still so portable that one man could have carried it with ease. What was accomplished by it excited the hopes of hydrographers, which time has wrought into the most gratifying and undeniable realisation.

Early in 1873 the Navy Department was preparing to make extended soundings in the Pacific Ocean. The Chief of Bureau of Navigation, charged with the execution of this work, asked the advice and assistance of Sir Wm. Thomson. He was good enough to order wire and such apparatus as his personal experience suggested, and to send carefully prepared instructions for effecting the object in view; in short, he did everything within his power to make the use of his apparatus successful. The substitution of it and its effective manipulation by Captain Belknap, United States Navy, marked an era of progress in deep sounding, and in possibilities of obtaining true ocean depths as truly as did the steamship mark an advance in traversing wide and stormy seas with celerity and certainty. At that time Belknap commanded the *Tuscarora*, and until the sounding apparatus was sent, had only the fitments that belong to vessels of war. Notwithstanding these disadvantages, the results obtained were eminently satisfactory. For specific information the scientist is referred to No. 54 of the Hydrographic Office publications, entitled "Deep-Sea Soundings in the North Pacific Ocean," 1874.

In a letter to the Chief of Bureau of Navigation in July, 1874, difficulties were stated in the use of the apparatus that happily had been overcome by Belknap. Sir William wrote:—"I have therefore resolved to alter the apparatus considerably, and am preparing for trials on a new plan which I hope to carry out in the five or six days we shall remain here, and, if possible, shall write you reporting the result." In reply to this note, he was informed with as little delay as possible in relation to the several modifications made by Belknap, which enabled him to get soundings in the most satisfactory manner in depths of more than 4,000 fathoms. Sir William expressed by letter, and publicly, his gratification at the admirable results obtained by Belknap, and his thanks for the specific information sent him relating to the modifications of apparatus that had been made.

In depths of 2,500 fathoms, Belknap found it necessary to make several additional revolutions of the drum by hand, on the sinker striking the bottom, to prevent jerks and strains on the wire which otherwise would have occurred from the rolling of the ship. This necessity was due to the almost instantaneous ceasing of the drum to revolve on the sinker touching the bottom. He reported his soundings at this depth as probably more accurate than many casts in depths of 100 fathoms with an ordinary lead and line. He added:—"I expect to accomplish all the work with it (Sir William Thomson's apparatus) which the department has assigned me, and, if I succeed, no greater compliment could be paid to the genius of the inventor."

The winding up of miles of wire on a light drum gave a cumulative pressure on the original apparatus in deep soundings such as to make a continuous system of repair necessary, and finally the substitution of steel drums in the naval service.

To fully appreciate the advance made through the use of this apparatus, it is necessary to bear in mind the tons of rope required to reach depths of four or five miles, and its rapid deterioration from use, the cumbrous apparatus, the slowness of the process even under the most favourable conditions, and what is of greater import, the uncertainty as to the actual depth sounded, arising in part from the under currents of the ocean carrying great bights of rope in one or more directions, and in part from the very small proportion the weight of the sinker must bear to the hemp line, but in a more marked degree from the "stretch" of the rope under tension, and the gradual shortening of it as soon as the sinker reached the bottom.

The report of the Secretary of the Navy for 1874, p. 61, discusses the advantages gained by the use of wire as follows:—The small amount of weight and space required for the apparatus; the large weight of the sinker relatively with the weight of the wire necessary even in sounding the greatest depths, and the very little surface friction of wire in its descent. Miles of wire have very little "stretch" at ordinary tension, and hemp line a great deal, from which, in the first case, the indications of the dynamometer would be almost instantaneous, and in the second would be obscure and quite uncertain as to the exact depth and moment when the sinker reached the bottom. Other advantages are the ease with which the wire is preserved from deterioration. It is stated further: "The problem of measuring the exact depths of the ocean and bringing up parts of the soil from their beds may now be regarded as solved."

The deepest sounding known was taken by Belknap off the east coast of Japan, 4,655 fathoms, a little more than 5½ statute miles in depth. He took 304 soundings of 1,000 fathoms or upwards, mean time of descent for the first 1,000 fathoms, 10 min. 6 sec.; 161 of 2,000 fathoms or upwards, time of descent in the second thousand, 11 min. 36 sec.; 38 of 3,000 or upwards, time of descent for the third thousand, 12 min. 40 sec.; 9 of 4,000 fathoms or upwards, time of descent for the fourth thousand, 15 min. 54 sec. The rate of reeling in by hand was much slower than now attained by the use of steam power, yet it was surprisingly rapid and easy in execution in comparison with the reeling in of hemp line.

In the great depths off the east coast of Japan, with the strong currents, Belknap's appliances were in fact taxed beyond a perfectly satisfactory execution, the wire having parted on one occasion at a depth of 4,643 fathoms, before reaching the bottom, and again in reeling in, after sounding in a depth of 5¾ statute miles. Larger wire and heavier apparatus can develop beyond a doubt the depths called by the Germans the "Tuscarora Deep." As now supposed from the soundings taken, this deep water lies at a mean distance of 120 miles from and parallel to a line drawn from the most northerly Cape of Niphon and the most northerly Kurile Island. This is a general direction of N.E. ¼ N. It appears to be at least 250 miles in length, and is probably much longer. Captain Belknap justly says that these extraordinary depths contiguous to a region of elevations afford a field of operations of great interest to the hydrographer.

The soundings made by Belknap comprise an arc of a great circle between the northern part of the Island of Niphon, the Aleutian Islands, and Puget Sound; another line between San Diego, Calvia, the Sandwich Islands, and the Bay of Yokohama; and a development of the true ocean bed from Puget Sound to San Diego. They reveal a dozen or more submerged elevations, veritable mountains "full many a fathom deep."

In fact, these soundings furnish the first extended and undeniable development of extraordinary and abrupt inequalities in the depths of the sea far away from the land. We owe this to the inventive genius of Sir William Thomson, and to the professional capacity of Captain Belknap, who not only knew how to make the best use of what he was furnished with, but also had the capacity to cure defects in the apparatus, such as they were. In depths of 3,000 fathoms he used a detachable sinker of 55 lbs. In greater depths he supplemented this with 20 lbs. to 30 lbs. of lead. In order to secure specimens of the bottom in larger quantity, Belknap designed several cups, one of which is now unsurpassed for efficiency by whatever modification or other design, as it did its work perfectly.

Although at the time these soundings with wire were determined on the superintendent of the Coast Survey of the United States hardly hoped a favourable result from the use of wire, as it had not been adopted by the *Challenger*, which had been fitted out for scientific investigation some months before, so able a scientist was not slow to adopt what Belknap had shown was so admirable. In Sigsbee's "Deep-sea Sounding and Dredging," published by the Coast Survey, Washington,

1880, we find, chapter 1:—"In August, 1874, the *Blake*, Commander John A. Howell, U.S.N., was provided with one of Sir William Thomson's sounding machines for wire." Commander Sigsbee in the following months made modifications in the apparatus, giving additional facility and rapidity of execution in sounding, but nothing could be added to the accuracy of the results that had already been obtained by Sir William and Belknap.

In the soundings of the Coast Survey, executed by Sigsbee, Bartlett, Tanner and others, we have a veritable revelation in the contours and depths of our coasts. They have brought to our knowledge the wonderful cleft in the crust of the earth on the line of the Hudson River extended 100 miles beyond Sandy Hook. Scarcely less interesting, but not so startling, are the plaster casts of the Gulf of Mexico, and of the Carribean Sea. It is a grateful duty to indicate to whom honour is due that the depths of seas are no longer an unrevealed and unfathomable mystery; that much is now known, and that ocean depths in all navigable seas will ere long be placed on maps with far more accuracy than are the heights of mountains above the level of the sea.

THE "ROUSSY" ELECTRIC LIGHT MODERATOR.

[A COMMUNICATION.]

SINCE the introduction of incandescent electric lighting many attempts have been made to invent simple apparatus, working with precision and safety to regulate, according to requirements, the intensity of light of each individual lamp on the same circuit.

The apparatus most nearly approaching the object aimed at before the invention of the "Roussy" moderator was the "Stanley" regulator, by which the electric current was made to pass on the way to the lamp, through a resisting medium formed with a certain number of carbon discs, piled up on each other, and placed between two metallic discs, one of which, bearing a screw, presses the carbon discs against each other.

According to the degree of this compression the carbon pile thus formed offers more or less resistance to the electric current, and it is possible, therefore, to graduate the luminous intensity of the lamp by screwing or unscrewing.

This arrangement had a great inconvenience, which is probably the reason why the "Stanley" regulator has not come into general use. In the course of its employment such a heat developes itself in the carbon pile that it causes an expansion of each of the discs forming the pile, the length of which is thus increased. By the ends of the pile touching the two fixed metallic discs an automatic compression of the carbon discs is produced, which is equivalent to an involuntary effect of the screw above described, and which causes an involuntary and automatic increase of the luminous intensity of the lamp.

For instance, after having regulated the intensity of a lamp to a force of, say, eight candles by means of the "Stanley" regulator, it used to happen that after some hours' lighting, when the resisting medium had become heated, the lamp produced a light equal to 10 or 16 candles without anybody having touched the regulator.

By numerous experiments and continued observations upon the circuit of Edison lamps used in the mills of Gilamont, their owner, Mr. E. L. Roussy, the first inaugurator of incandescent electric lighting in Switzerland, has succeeded, without being acquainted with Mr. Stanley's invention, in constructing a regulator, or, as he calls it, a moderator, also composed of a resisting carbon medium, but not showing that important drawback just described.

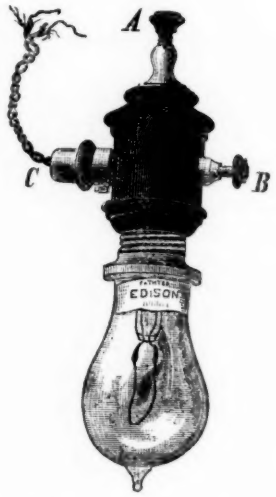
The illustration shows a lamp-holder with the "Roussy" moderator, and bearing an Edison lamp. A is the regulating button of the moderator; B is the interrupter; C is the aperture for inserting the wires.

Mr. Roussy places inside the lampholder a small hollow cylinder, made of glass or some other insulating substance, and filled with carbon powder. This powder is put into contact with one of the poles of the lamp, in order that the electric current must pass through it before getting to the lamp. A screw enables one to compress the powder more or less in its receptacle.

If a strong pressure is exerted upon the powder it will form a compact conductor, letting the current pass to the lamp without impediment. But if the regulating button is unscrewed the electric current causes an automatic separation of the compressed powder, and the more this becomes loose the greater will be the resistance to the current and the less the lamp will glow.

What happens now when a resisting medium thus composed becomes heated?

Numerous and protracted experiments have been made to clear up this question, and they have shown that the heated state of the powder in this regulator does not alter the resisting property of the latter, whilst the mechanical compression of this same powder will reduce to a certain degree the resistance it offers against the current passing through it.



This result, although practically attained, seems contradictory, as it must be conceded that in the "Roussy" moderator, as well as in the "Stanley" regulator, the heating must necessarily be followed by an expansion of the elements.

However, the difference in the results may be explained by the sole fact of the difference in the form and in the manner the elements are disposed in these two systems of regulating. When carbon powder is compressed in a cylindrical cavity by a screw acting like a piston, the pressure thus produced causes little or no settling down. The particles more or less reduced bear more heavily upon each other, increasing the number of their points of contact, but leaving between the particles gaps that will allow the particles to change their place relatively to their neighbours, when the expansion from heat of each particle causes lateral pressures, which instead of increasing the points of contact only produce a natural settling of the powder.

Messrs. A. de Meuton and Cuénod, of Geneva, have undertaken the construction of lampholders with the "Roussy" system of regulators.

Mr. E. Imer-Schneider, consulting engineer, Geneva, can give all desired information with respect to patent rights, &c.

Proposed Technical School at Elbeuf.—Efforts are being made by the Industrial Association at Elbeuf to establish a technical school which would be on a level with the institutions of a like description at Bradford and Leeds. The scheme has been drawn up in a very detailed form, and embraces a three years' course of study. There will be eight professors, with a competent body of technical assistants. The general expenses would amount to £2,000 a-year, and the necessary machinery and appliances would cost £8,000, the erection of a suitable building being estimated at about £3,000 more.

ON A STANDARD TANGENT GALVANOMETER.*

By Professor SILVANUS P. THOMPSON.

IT is known that in those tangent galvanometers wherein the coil consists of numerous turns of wire, the simple formula used for the case where the coil consists of a single turn of given radius is no longer applicable, but requires the introduction of certain corrections, depending on the breadth of the coil, and on its radial depth. A coil of great radial depth in proportion to its breadth acts as if its effective mean radius were less than the arithmetical mean radius of the various turns, because of the greater effect of the inner turns which are nearest to the needle. A coil of great breadth in proportion to its radial depth acts as if its mean radius were greater than the arithmetical mean radius of the several turns, because those turns which lie on the ends of the annular cylindrical surface are at a greater distance from the needle.

Now, since the effects of breadth and depth are opposite, one making the effective mean radius greater, the other making it less than the actual mean radius, it is evident that there ought to be a certain possible proportion between depth and breadth, which, if observed in the construction of the coil, will have the effect of causing these two influences to cancel one another. The object of this paper is to make known that proportion which fulfils this condition.

Maxwell has in his treatise made a similar calculation for the case of the Helmholtz two-coil galvanometer, for which he finds that the proportion between breadth and depth ought to be 31 : 36. Maxwell's equations (see Art. 711 "Electricity and Magnetism") also furnish a basis for the calculation which it is desired to apply to the one-coil tangent galvanometer.

We will adopt Maxwell's nomenclature, and write :—

A = arithmetical mean radius.
ξ = depth of coil in radial direction.
η = breadth of coil in axial direction.

Then, we may write as the value of the current i (in absolute measure) the following expression, involving a series of spherical harmonics as functions of the angle θ between the axis of the needle and the axis of the coil

$$i = \frac{H \cot \theta}{G_1 g_1 + G_2 g_2 Q'_1(\theta) + G_3 g_3 Q'_2(\theta^2) + \&c.}$$

where the coefficients, G_1, G_2, &c., refer to the coil, and g_1, g_2, &c., to the needle, and H is the horizontal magnetic field at the centre of the coil. For a symmetrically hung uniformly magnetised needle of length $\frac{1}{2}l$, and for a coil of rectangular section, the following are the values of the coefficients :—

$$g_1 = 2l.$$
$$g_2 = 0.$$
$$g_3 = 2l^3.$$
$$g_4 = 0.$$
$$G_1 = \frac{2\pi n}{A}\left\{1 + \tfrac{1}{12}\frac{\xi^2}{A^2} - \tfrac{1}{8}\frac{\eta^2}{A^2}\right\}.$$
$$G_2 = 0.$$
$$G_3 = -\frac{\pi n}{A^3}\cdot\left\{1 + \tfrac{1}{2}\frac{\xi^2}{A^2} - \tfrac{5}{8}\frac{\eta^2}{A^2}\right\}.$$
$$G_4 = 0.$$

The higher terms may be neglected. The principal term to take into account is, of course, G_1. Looking at the numerical coefficients of the terms containing ξ and η in this expression, we see that these terms will vanish, provided

$$\frac{\xi^2}{12} = \frac{\eta^2}{8},$$

which is therefore the equation of condition, and may also be written :—

$$\xi : \eta :: \sqrt{3} : \sqrt{2}.$$

The nearest convenient whole numbers that suit this relation are 11 : 9, and this is very nearly accurate, as the exact proportion is 11·016 : 9.

Accordingly the author has constructed a galvanometer on the following plan :—A mahogany ring was built up, and turned so as to have a rectangular channel 2 centimetres broad and 2·5 centimetres deep, the mean radius of the channel being slightly over 25 centimetres. Some silk-covered copper wire was chosen, of such calibre that nine turns would exactly lie side by side in the channel; and 11 layers were wound, making 99 turns in all. Each layer when wound was separately paraffined, the paraffin being smoothed off so that the turns of wire lay in square order above one another. The advantage presented by a coil of this aperture is that when it is set up the magnetometer for determining H can be set up *in situ* at the centre of the coil; and in fact the same magnet arrangement used for the deflection experiment is used as the magnet of the galvanometer. It consists of four pieces of watch-spring each 1 centimetre long, mounted behind a vane of mica.

Here, then, $g_1 = 1$, $g_3 = \cdot 25$. If the $\eta : \xi$ were *exactly* as $\sqrt{2} : \sqrt{3}$, then G_1 would have the value $\frac{198\pi}{25}$. As a matter of fact it differs from that value by less than one one-millionth part, the term in brackets in the full expression for G_1 being equal to $1 - 0{\cdot}000005$. The term G_3 also becomes very small, for though the dimensions 11 : 9 in the cross-section of the coil do not in this case entirely eliminate corrections, owing to the different coefficients, the fact that these corrections have to be divided by the third power of the arithmetical mean radius makes them negligibly small. The error thereby introduced, even for large deflections of the needle, is far less than the errors inevitable in the determination of H, which cannot be relied upon, except by taking the mean of a very large number of observations, to a greater accuracy than one part in one thousand.

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THE PHYSIOLOGICAL BEARING OF ELECTRICITY ON HEALTH.*

By W. H. STONE, M.A., M.B., F.R.C.P.

(*Continued from page* 261.)

The only thing which now remains, before speaking very briefly of what electricity will do, is how shall we obtain a standard of measurement? In this case we know the electromotive force, but if the *Lancet* is right there is no mode at present of measuring alternating currents. There are many persons in this room who can state the contrary of that; and when I wanted to find the means of doing such an impossible thing, I went to the Cantor lectures of our Chairman. There I found a very simple formula which does it in an instant, and which is a formula that has been used by Dr. Hopkinson. Still lower is the ordinary formula for the electrometer charged to a considerable potential.

$$c = \frac{v_1 - v_2}{r_1}$$

$$d = k\,(v_1 - v_2)\left(v - \frac{v_1 + v_2}{2}\right).$$

There is another method which is more practical for ordinary purposes, namely, the dynamometer. Two years and one month ago I brought a little instrument, made by my own hands in my own little workshop, before the Physiological Society. It is a small dynamometer in which the ordinary heavy coil, instead of being made of copper wire, is made of aluminium wire. That wire, I say distinctly, for a given mass, is far the best conductor existing of electricity, and if a light coil which shall move with a small movement is needed, one had far better use aluminium than any other metal. It was severely criticised by the Physiological Society at Oxford. In the first place, I was told by a member of the firm of Siemens that I could not get contact, and that the contact would be found to fail. This instrument has been knocking about my lecture-room and laboratory for twenty-five months; the contacts are made simply by twisting the wires together, and the variation of resistance is not one-tenth ohm. I was also told that it had been tried for siphon recorders instead of a gold coil, but was not half so good. On that point I leave everyone to his own opinion, but I adhere to mine that a light aluminium coil is better than a heavy coil, at any rate for my purpose. I purchased recently a very expensive dynamometer, also designed by Prof.

Kohlrausch, of Wurtzburg. It is a beautiful instrument: a plate of platinum dipping into a vessel of sulphuric acid makes one contact, the other is a fine silver wire. In mine the contacts are made with a strong silver-gilt wire used for making officers' epaulettes: it is hard wire, and keeps its elasticity exceptionally well. No doubt the German instrument measures alternating currents, which the *Lancet* says cannot be done, but it is a long time about it; it is very sluggish. I have to put on a short contact key, then take the reading telescope (also a beautiful piece of mechanism) with metre scale underneath, only with the numbers inverted; it is read off with the telescope at a metre distance, and at about the end of four or five minutes it has gone up to its highest deflection. Of course with this current it goes up by little jerks; and by the time it has done so the battery has run down: and if anybody would tell me of a battery which would stand that treatment I should be deeply obliged to them. Therefore that sluggish heavy copper wire weighing an ounce or two, will not do. This one, with the despised aluminium, gets up to its full deflection instantly, simply because it has so little moment of inertia, and long before the battery has time to run down I have my readings; and the reading of this scale at one metre's distance with this telescope with the small induction coil attached to the metre bridge, was on the scale the exact number of the days in a year, viz., 365 millimètres, a deflection abundant for any purposes. Here I had a reading in dynamometer measurement of the electromotive force between two terminals of this particular coil. This had to be compared with a quadrant electrometer; but, unfortunately, I had not got a quadrant electrometer, nor did I know where to get one. After spending £50 on these instruments you see here, I wrote, hoping the Royal Society would assist me, but I twice received a formal refusal on a printed form. The question was, how was I to get hold of a quadrant electrometer, of which the constants were determined, and by which a poor working physician and physiologist could make a single determination without buying an expensive electrometer, which would cost six months' work to get in order? I think that if such a Society as this were to interfere in favour of us poor physiologists, and let us have the use of some standard instruments, it would fill up a very decided gap. It is not as if it were wanted on every day of the week, but only three or four times, just to get our constants. I accordingly appealed to my good friends at Cooper's Hill, Prof. McLeod, Prof. Stocker, and Mr. Gregory. They stood by me magnificently, and these measurements were made last week. At last we got the right determination, which comes as nearly as possible to the electromotive force when the whole secondary current is allowed to enter the electrometer—about 401 volts. When it is divided on the bridge, if it is equally divided half goes through the patient and half through the fixed coil, so that we are dealing with a total electromotive force of 40 volts, which gives a deflection on this dynamometer of 365. The deflection in this electrometer was about 1,070.

Though feeling that I ought to finish, I am tempted to say one word about the therapeutic value of electricity. Here we are in a very initiatory stage. I have shown that up to the present our very measurements are not made, and we do not yet know the tools we are dealing with. This Society of Physicists will, I am sure, enforce what I say. Before you begin to work with any tool you ought to know its weight, size, and efficiency, and this we were entirely ignorant of up to now. Then what can we do? There is no doubt that electricity, although it is not life, is very much akin to the principle by which impulses are transmitted in the human body, and therefore its effect both on muscles and nerves is very decided. Hitherto, as regards the curing of any diseases, I fear more because of our ignorance how to use it than of its want of intrinsic power, we have not achieved any great result. We can do something where muscle is wasted; in cases allied to palsy in its various forms, where the palsy is more or less due to nervous disease, we can get the muscles exercised. I am in the habit of telling my hospital patients that I can give them a two miles' walk while they stay in bed. By attaching an intermittent current to the foot they will have the effect of a two miles' walk without moving out of bed, and the muscles will plump up and get firm and strong; and if the nervous disease which has caused the affection is only temporary, and is going to fade away, the muscles will not be left in an incompetent state with respect to the renewed nervous stimulus. It is also useful in various nervous diseases. I have known many painful neuralgias yield to a few properly applied currents. In certain diseases of the spine, such as locomotor ataxy and progressive muscular atrophy, you can do a great deal in a curative way.

The eliminative use of electric currents has not been utilised as it should be. I have thus extracted copper, mercury, and silver from the body; and lead has long been got out of the system by this means. The electrical current is a mode of loosening these metals in the system, and then eliminants of a chemical type can be used. For copper I have used sulphate of ammonia, and the excreted copper increased immediately. In the case of copper, sulphate of ammonia answered perfectly. In the case of mercury, iodide of potash has long been known to be efficacious. In the case of silver, I have been using hypo-sulphite of soda. I got the platinum plates well coated with silver and an abundant secretion of hypo-sulphite of soda. I find that agrees perfectly well with the patient.

Beyond this, it is proved also that there is an action of electricity upon that mysterious disease, diabetes. This curious physiological fact I brought before the British Association three years ago. There can be no doubt that the quantity of sugar and the quantity of excretion diminishes exceedingly if you pass a current across what is called the dialectic tract of the brain, namely, floor of the fourth ventricle; unfortunately the influence is transient. Diabetes is an obstinate and persistent disease; and though I am almost certain to be able to produce a result, it evanesces after a week or two. Of course, if I could find any way in that period of pause or rest of lessening the cause—of which we are very ignorant now—of the increased excretion of the abnormal element, sugar, this might come in as an element in a rational and successful cure; but at present, as my old colleague Dr. Ord suggests, the effect is probably on the vaso-motor nerves, due to a power of contracting the calibre of the vessels by the action on the vaso-motor nerves. There can be no doubt that the floor of the fourth ventricle is in some way connected with this morbid excretion of sugar; of the intermediate stages we know very little. A fact has come to my knowledge a few days since, which very strongly confirms the idea that there may be some vaso-motor action when a current is passed through the base of the brain. It comes to me from another distinguished member of this Society, Colonel Bolton. He tells me he finds a moderate continuous current passed through the head from the back of the neck to one of the hands, when you are sleepless from overwork or any other cause at night, will act as an efficient hypnotic. If that is a fact, and it was given to me entirely spontaneously without any leading up to, purely and simply as an observed fact, we have got hold of something very valuable. It agrees extremely well with the effects known in the case of hypnotics like chloral. We all know that the condition of the brain during sleep is anæmic, the supply of blood is lessened, function becomes to a certain extent diminished, and the body falls off into the condition of repose which is the twin sister of death. No doubt here are joined together the two terminals of what I began with. This is the explanation then. The vaso-motor action—the contraction of the arteries at the base of the brain—is the cause of many fatal accidents; but if we can also say that it is the cause of the beneficent action of refreshing sleep, we shall to a certain extent redeem the character of the agent, and show that it does some good to compensate for its occasional evil results.

The CHAIRMAN (Prof. W. Grylls Adams, F.R.S.) said they had had a most interesting lecture from Dr. Stone, who had thrown out some practical points which would not be accepted without question in some cases, and on other points he had directly applied to electricians to throw out ideas or give him information. For instance, he had asked them to tell him of a kind of battery which he could use for certain purposes, and also what kind of instrument would be best for the special investigations he had in hand.

Mr. LATIMER CLARK said he was in communication with the officers of the Russian sloop *Livadia*, on which the accident occurred, and he would endeavour to get some detailed information on the subject, and communicate it to Dr. Stone. The subject of the application of electricity to medicine has appeared in all ages an important one, and no doubt many had wondered why so little practical success had hitherto been achieved. He felt that now perhaps for the first time they were in the right channel, for Dr. Stone was dealing with the subject in a thoroughly scientific manner and spirit, and if anything could be done to apply medical electricity to the benefit of mankind, Dr. Stone was likely to achieve it. There seemed to be a sort of vague idea that currents of high tension were painful and dangerous on account of their high potential, but that was a popular error which should be exploded. He believed the human frame was precisely like a galvanometer—that the physiological influence of an electric current was solely proportionate to the quantity of electricity which actually passed through the body, and not at all to its tension. Of course high tension caused more electricity to pass through the body, and Dr. Stone produced the same result by giving better conductors to the hands and feet, but he conceived they should regard the human frame as a galvanometer, and that the physiological effects were proportionate to the quantity passing, and not to the potential of the current which passed.

Dr. KILNER: There is one point in Dr. Stone's valuable paper to which I must take exception, and that is the method he has been describing for obtaining the resistance of the human body. He has measured the resistance either from hand to hand or from foot to foot, or from hand to foot, thus including a large portion of the body, without any attempt to localise the resistance of the different parts. Although he has found the resistances taken in this manner vary from time to time (and supposing, for an example, the resistance is measured from hand to foot) he is unable to say whether the change is due to an alteration of resistance that has occurred throughout, or only in the arm, or in the trunk, or in the leg.

For the last two or three years I have been in the habit of measuring the resistance of the human body, only in a different manner, aiming at obtaining the local resistance rather than that offered by a large extent of the body, because by so doing a more useful knowledge is obtained, as the resistance of a diseased limb not only very frequently differs from what it would be in health, but that under certain circumstances the local alteration of the resistance has enabled me to give a more certain prognosis than I could have done without. The method I employ was fully described last year in the *Lancet*, and is, leaving out the details, as follows:—I place the two electrodes at a convenient distance apart, and measure the current by means of a vertical mirror galvanometer as quickly as possible, and then place the electrodes at exactly half the distance apart, and again measure the current, using the same battery. From this, if the area of the electrodes be known, not only can the resistance of the epidermis, but also

that offered by the subjacent tissues between the two electrodes, be calculated. Another advantage accrues from this method, viz., that as the resistance is altered after the passage of the current from what it was previously, the state of contraction of the local blood vessels can be determined, because the current dilates them, and as the blood is the best conductor of all the animal tissues, the resistance will decrease in direct proportion to the increase of the amount of blood to the part.

This leads us to another point just touched upon by Dr. Stone, namely, the effect of the current upon the circulation. I have this day finished a paper upon the subject, and may state that there is a great difference between the constant current and one obtained from an induction coil, inasmuch as the latter exerts its power chiefly upon the general circulation by lowering the arterial tension, no matter where the electrodes may be placed, while the former is almost entirely local in its action.

Mr. BEEMAN said the accident at Hatfield took place nearly half a mile away from the machine, and, though no doubt the coroner's jury brought it in that the man died from electric shock, he believed that if Dr. Stone communicated with the medical officer it would be found that the man was suffering from heart disease, and was six yards away from the wire which was supposed to have killed him. There was not the slightest mark on his body to indicate that he had touched the wires at all.

Mr. GREENHILL said if a man were suffering from disease of the heart and got a sudden shock it was very probable he would die, and his death would be so recorded, usually speaking; but if he happened to be near a dynamo machine, the papers would record that he was killed by a shock of electricity.

Dr. STONE said he had a newspaper report which bore out very much Mr. Greenhill's remarks, for, though attributed to electricity, it was an obvious case of heart disease.

The CHAIRMAN, in proposing a vote of thanks to Dr. Stone, said he must make one remark with regard to the accuracy of one of the instruments referred to. He was not sure that electricians would be quite satisfied with the accuracy of what was put forward by Dr. Stone, viz., that resistance could be measured to within $\frac{1}{10}$ of an ohm by the instrument in which the aluminium wire was used. Nowadays electricians would not be satisfied with anything which did not give the resistance in ohms carried to several places of decimals.

Dr. STONE, in reply, said he should be very much obliged to Mr. Latimer Clark if he would kindly get him the information in regard to the accident. It seemed to him that rapid fluctuations of current created the danger, not the actual quantity of current, and even then the action was more marked on the unstriped or involuntary muscles than on the voluntary muscle fibre. Most of his experiments had been conducted conjointly with Dr. Kilner, who had worked with him now for several years, and therefore his experience naturally coincided. It was quite impossible to attempt to distinguish between the tissues of the body when a current was passing through them all. It passed through them indifferently, and you could not separate it, or say that the blood, the muscle, or the nerve conducted so much. As far as they knew, the nerve, to ordinary electricity, instead of being what it should be, a good conductor, was a remarkably bad one; muscle was much better; and water, simple serous fluid, or saline solutions, were better than all of them. He thought that the body followed the law, as regards heat, more of solid than fluid conductors: where dropsy took place resistance went down to half, the dropsical fluid being a much better conductor than healthy muscle, bone, or tendon. As to the movements of a conducting fluid, it did not move in a magnetic field; and nobody but the author of a pamphlet he had quoted suggested that there was in the interior of the body a magnetic field of any appreciable force. He certainly was not aware of it, or of the influence of magnets in his neighbourhood, nor had he ever been able to influence himself by the neighbourhood of magnets. He had tried the experiment on a large scale, and it was now being repeated by a society at his laboratory, but excepting the imagined sight of flames by some hysterical girls, nobody had been able to point to any effect produced by magnets whatever. He had used a battery of fifty 3-quart cells and a large electro-magnet, and had lain down on the pillow with his head between the poles of this enormous magnet, but though it was competent to rotate a ray of light through a number of degrees, it could not rotate him through one.

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(*Continued from page* 253.)

ON the 29th November, 1850, the National Assembly adopted a law, referring to private telegraphic correspondence, by which any person was allowed to correspond by means of the electric telegraph of the State, after having undeniably established his identity; it thereby gave to the public the use of that marvellous instrument, which until then had been exclusively reserved to the service of the State.

Under the first Republic the aerial telegraph first saw the light; under the second Republic the electrical telegraph was given to the public. It was the third Republic, which, by passing the law of reforms, rendered the use of it accessible to everybody. The telegraph tariffs have passed through three different phases.

The basis of the laws of the 29th November, 1850, 28th May, 1853, and 22nd June, 1854 was that the tariff be proportional to the distance.

According to those laws the price of a message of 20 words was composed of a fixed rate of three francs, and changeable rate at the rate of twelve centimes per myriametre. The law of the 28th May, 1853, reduced the fixed rate to two francs, and the changeable rate to 10 centimes per myriametre. A new system was adopted by the laws of 18th May, 1858, 3rd July, 1861, 27th May, 1863, 13th June, 1866, 4th July, 1868, 8th May, 1869, 29th March, 1872, and the decree of the 13th August, 1864. It was a step towards the uniform tariff, but it nevertheless maintained two kinds of rates, a general rate and a rate applicable to messages exchanged, either within the boundaries of one and the same department, or between two neighbouring departments.

The rate of departmental messages was successively 1 franc (1 to 15 words), 1 franc 50 centimes and 60 centimes (1 to 20 words). The rate of inter-departmental messages, on the other hand, was 2 francs, 1 franc, and 1 franc 40 centimes. Finally, the uniform tariff was created by the reform law of the 21st March, 1878.

It should be observed that all those laws, except that of the 29th March, 1872, have successively and progressively reduced the tariffs. This latter law formed part of the fiscal measures taken by the National Assembly, to meet the exceptional expenses resulting from the war and the invasion.

The law of telegraph reform has been voted as the result of two bills of the Government, of five proposals, emanating from the parliamentary initiative and of two amendments.

The first bill, brought in on the 11th November, 1876, re-established, as the rate of messages of twenty words, the tariffs which were in force previous to 1872.

Four other proposals, emanating from the parliamentary initiative, were made by Messrs. Talandier, Desloye, Eschassériaux and Lecesne.

Those different bills were sent back to the Committee of the Budget. The latter proposed, by voice of its reporter, to adopt the word-rate, augmented by a constant, independent from the number of words. It maintained two kinds of rates.

The first discussion of the bill took place on the 14th May, 1877. As with the postal reform, no decision was arrived at, because of the dissolution of the Chamber, and the telegraph reform was adjourned for nine months.

On the 11th January, 1878, the Chamber of Deputies had a new bill of the Government submitted to them, which sanctioned the word-rate system, without constant. After a close discussion the Chamber voted this bill on the 4th February, 1878, on the report of Mr. Parent.

In the Senate, like in the Chamber of Deputies, urgency was declared for this law, and it was voted without discussion on the 11th March, 1878. It was published on the 21st March, 1878, and put into force two months and a half before the delay of four months fixed for its application had elapsed.

In the discussion in the Chambers, the Government undertook to reduce the rate of the messages from Paris to Paris so soon as the completion of the pneumatic system would allow of this reform; the law, however, authorised it to take this measure by ministerial decree, except that the new tariff would, later on, have to be submitted to the Chambers for approval.

This promise has been kept, and the new service of the special telegrams at reduced rates works since the 1st May, 1879. The law of 1878, by doing away with the system, which was formerly in use, of the maximum of 20 words, with a progressive rate for every ten additional words, as well as the distinction of zones, and by substituting for this the uniform rate of five centimes per word' with a minimum charge of 50 centimes, has placed France amongs the nations which offer the telegraphic service at the lowest prices. The word rate offers many advantages; it is easily understood both by the public as well as the service. To show the exact amount of the decrease in receipts resulting from the whole of the postal and telegraphic reforms, it is not sufficient to take the difference between the receipts before and those after the application of the new rates.

The former in reality call forth an increase of correspondence which would falsify the obtained result, since the second amount would apply to a much larger traffic than the first one; the total amount of the decrease in receipts should be diminished by the surplus receipts which would have made themselves apparent.

The real decrease is the difference between the product of the rates previous to the reform and the receipts which the new rates would have produced with the same traffic.

By calculating separately for each kind of correspondence, the difference between the receipts of 1877 and those which the same traffic would have given with the new rates, and in adding those different totals together, we obtain the grand total of the decrease in receipts.

	FRANCS.
The total of the annual decrease in receipts resulting from the postal reforms, amounts to	32,219,853
That from the telegraphic reforms to ...	2,940,260
Or a total of (*sic*)	36,160,113

Since the laws of reform further reductions in the rates have

produced the following decrease in receipts which have never been taken in account in the estimate of receipts.

	FRANCS.
POSTS.	
Reduction from 50 to 25 centimes for registered letters	1,458,000
Reduction in International rates (decrees of the 16th and 19th April, 1878)	1,211,042
Reduction in rates for the United States, the French Colonies and various foreign countries (1878—1882)	350,000
Suppression of the extra rate for letters to the second zone of the Universal Postal Union	159,000
TELEGRAPHS.	
Reduction in the rate for telegrams to Algiers	589,736
Creation of telegraph cards and sealed telegrams	70,909
Reduction in International rates	1,975,000
Reduction in rates received for private telegraph wires	70,000
Concession of special subscriptions for the service of the press (because of its nature this reduction cannot be stated precisely in figures)	—
Or a loss of	5,883,687

The calculation as regards the prepaid objects of postal correspondence is made from the average net rates. For the sale of postage stamps, however, the State only receives 99 per cent. of the tax really paid by the public, because of the commission of one per cent. allowed to the vendors.

The real decrease in receipts is therefore $\frac{1}{99}$ more than the amount we have stated, after making deduction for telegraph receipts and for unpaid letters, which brings the total decrease to 42,328,940 francs.

It should be observed that if we applied in the same way the rates received previous to 1878 to the traffic of 1882, we would obtain an amount which would be 70 million francs more than the actual receipts.

The results obtained by the reform, as regards the postal and telegraphic traffic, have been very satisfactory.

It would lead us too far to give here the detailed tables, &c., referring to the postal traffic. The following, as referring to telegraphs, may be of interest.

INLAND TELEGRAMS.

Years.	Number of taxed inland telegrams.	Number of transmitted telegraph cards.	Total.	Increase over the preceding year.	Percentage of the increase.	Remarks.
*						
1872	5,395,762	..	5,395,762	1,023,850	23·41	* 4,471,932 telegrams in 1871.
1873	5,673,339	..	5,673,339	277,597	5·14	Increase in 1877 over 1871: 2,808,704, or 64·14 per cent.
1874	5,993,835	..	5,993,835	320,476	5·64	
1875	6,595,790	..	6,595,790	601,955	10·04	
1876	7,053,715	..	7,053,715	457,925	6·90	
1877	7,180,636	..	7,180,636	126,921	1·79	
Total of the six years .	—	—	37,893,097			
1878	10,007,363	..	10,007,363	2,826,727	39·36	Increase in 1883 over 1877: 13,969,806 or 194 per cent.
1879	12,361,037	298,300	12,659,337	2,651,974	26·50	
1880	14,927,808	640,235	15,568,043	2,908,706	22·97	
1881	17,320,643	1,040,395	18,360,138	2,092,095	19·22	
1882	18,146,465	1,465,595	19,612,060	1,451,922	5·66	
1883	19,146,722	2,003,720	21,150,442	1,538,382	7·84	
Total of the six years .	—	—	97,558,283			

The year 1883 therefore gives, over 1877, an increase of 13,969,806 inland telegrams, or 194 per cent., whilst by comparing the years 1871 and 1877, we obtain, in favour of the latter year, an increase of 2,808,704 telegrams, or 64·24 per cent. only.

From the first year of applying the new tariff, its effect has shown itself very strongly. This is proved by comparing the yearly increase. Whilst the increase amounted to 320,000 in 1874, and 602,000 in 1875, it dropped to 458,000 in 1876, and even to 127,000 in 1877.

The reform introduced on the 1st May produced, in 1878, an augmentation of over 2,800,000 telegrams as compared with the amount of the preceding year, and the yearly increase maintains itself during the three following years at about 2,900,000.

It is useless to insist further on these results, which surpass the most optimist previsions.

We may, however, further observe that the total of the taxed inland telegrams during the years 1872 to 1877 has been 37,900,000; and that for the six following years this cipher was more than doubled and amounted to 97,500,000, thus showing an increase of 59,500,000 telegrams in favour of the latter period.

The international telegraph traffic, until in 1879, felt the effects of the high tariffs, and especially of the manner of rating, which made no difference between messages of 3, 4, or 5 words and those of 20 words.

Since the 1st April, 1880, the rating per word having been applied according to the Regulations of the Conference of London, a large increase took place in the international traffic, as shown by the following table.

In consideration of this date of 1880, it appears to us useful to compare the results of 1883 not only with those of 1877, but also with those of 1879.

YEARS.	Number of International Telegrams. Forwarded.	Received.	Transit.	Total.
1877...	993,942	1,006,820	365,187	2,365,949
1878...	1,177,597	1,160,363	421,521	2,759,481
1879...	1,211,810	1,125,620	494,817	2,832,247
1880...	1,578,957	1,413,256	683,796	3,676,009
1881...	1,952,056	1,655,244	769,465	4,376,765
1882...	1,875,613	1,512,893	759,994	4,148,500
1883...	1,940,916	1,526,866	700,000	4,167,782
Increase in 1883 over 1877	946,974 or 95 °/₀	520,046 or 51 °/₀	334,813 or 91 °/₀	1,801,833 or 76 °/₀
Increase in 1883 over 1879	729,106 or 60 °/₀	401,246 or 35 °/₀	205,183 or 41 °/₀	1,335,535 or 47 °/₀

The results of the reform in the international tariff are, as will be seen, nearly as remarkable as those of the inland reform. If the latter has doubled in less than three years the number of French telegrams, since the second year of the lowering of the international rates, has called forth an increase of 24 per cent. in the number of telegrams which we forwarded to foreign parts.

The number of messages received from abroad, or which pass through France, has also increased in considerable proportions.

If we add to the number of inland telegrams, as we have given it, the number of telegrams originating from the railway telegraph offices (421,385 in 1877 and 856,323 in 1883), and also the special telegrams from Paris (2,003,720 transmitted in 1883), we obtain for the grand total of the inland and international telegrams:—in 1877, 9,967,970 telegrams; in 1883, 26,174,547 telegrams; or an increase in 1883 of 16,206,577 = 162 per cent.

This is a considerable augmentation, to which we would not have been adequate but for the assiduous work of the whole of the staff, and the measures we have been obliged to introduce in the service.

It appears to us to be useful to see what is the relation between the rated and delivered telegrams in France, and her population.

We find for every 100 inhabitants

Before the reform	14·27 telegrams	in 1869
	21·40 „	1874
	23·13 „	1875
	24·75 „	1876
	24·83 „	1877
After the reform	33·51 telegrams	in 1878
	39·82 „	1879
	48·56 „	1880
	56·07 „	1881
	57·17 „	1882
	58·00 „	1883

The progress is continual, and since the reform, we advance rapidly towards rendering the use of the telegraph by the public more and more common.

It is interesting to bring face to face the results of the years 1869 and 1883 as regards the telegraphic traffic.

Designations.	1869.	1883.	Increase in 1883.	Percentage of the increase.
Taxed inland telegrams	4,085,408	19,146,722	15,061,314	368·66
Railway office telegrams	284,660	856,323	571,663	200·82
Special telegrams	..	* 2,003,720	2,003,720	..
Totals of the inland telegrams ..	4,370,068	22,006,765	17,636,697	403·57
Forwarded international telegrams ..	669,235	1,940,916	1,271,681	190·02
Received „ „ ..	677,447	1,526,866	849,419	125·38
Transits „ „ ..	142,085	700,000	557,915	392·66
Totals of the international telegrams	1,488,767	4,167,782	2,679,015	179·94
Grand totals of the telegraph traffic	5,858,835	26,174,547	20,315,712	346·75

* Transmitted in the offices.

The above figures show that the increase is very considerable; but it should be remembered that this large development of the traffic took place since 1878 for the inland messages, and since 1880 for the international telegrams.

The first, which amounted in 1869 to 4,370,068, in 1877 only came to 7,602,021; whilst in 1883 we counted 22,006,765. The international telegrams which in 1869 amounted to 1,488,767, in 1879 only came to 2,832,247; they attained in 1883 the number of 4,167,782.

(To be continued.)

NOTES.

Electric Lighting.—Provision is made for electric lighting in the new hall of the Court of Common Council, taken possession of for the first time on Thursday last week; but gas is being used at present.

His Danish Majesty's screw corvette *Fyen*, Commodore Macdougall, anchored at Spithead on Saturday evening last. The *Fyen* is a new man-of-war, and is now on her trial trip, having been on a cruise in the Atlantic in search of bad weather, for the purpose of testing her sea-going qualities under steam and sail. The vessel, which was constructed at Copenhagen, has engines of 2,700 indicated horse-power, and is built of steel plating 1½ in. thick, with iron frames, and an iron spur ram. There is an electric search light at each end of the bridge, while the interior of the ship is lighted by incandescent lamps.

From a Dublin correspondent:—The Sanitary Exhibition Buildings here have been lighted throughout by the Maxim-Weston Electric Company, Limited, of London, and the decorations will not be removed, as there will be another *fête* in aid of the Hospital Fund, when the Maxim-Weston Electric Company will again illuminate the grounds with Weston arc lamps, elevated upon masts. The lights on Saturday were very brilliant and much admired. We have no doubt the lights will shine as brilliantly as usual at the *fête*, when an equally numerous and fashionable attendance is expected. The above company will also, we understand, on Monday next give an exhibition of its incandescent system and new lamps, which we have no doubt will prove equally successful, and be one of the many attractive features of the exhibition. We trust the authorities here will endeavour, by co-operation with this company, to emancipate themselves from the thraldom of the gas company, in which scheme they will have the unanimous sympathy of every impartial citizen.

We understand that the Cleethorpes Gas Company has placed two patent Sugg's and Bray's gas lamps in position at Cleethorpes, one of 230 and the other 200-candle power, to demonstrate the efficiency of gas lighting in competition with the electric light. Cleethorpes is at present illuminated by means of the latter light, in conjunction with oil lamps, but the result is stated to be far from satisfactory. The new gas lamps have been burning now for some time, and, it is said, have proved quite capable of holding their own against the electric light, their illumination, moreover, being of a much steadier description than that given by the arc lamps.

The trial trip of the *Affonso d'Albuquerque*, the latest addition to the Portuguese Royal Navy, took place recently from Greenhithe. Built by the Thames Ironworks and Shipbuilding Company, Blackwall, the *Affonso d'Albuquerque* seems to be in every way admirably adapted for the purposes which she is intended to serve, as an efficient and well-equipped cruiser on the West Coast of Africa. The ship is a full-rigged cruiser, and will forthwith, after the sufficient test of her powers which has been made, be employed by the Portuguese Government in colonial service. She is 205 ft. long, and her breadth of beam is 33 ft.; she is fitted with horizontal compound engines of 1,000 indicated horse-power, by Messrs. Humphreys, Tennant & Co., of Deptford. The cabins, neatly and elegantly decorated, were well illuminated by Messrs. Siemens Bros., by means of the electric light, the dynamo being driven by a Goodfellow and Matthews three-cylinder compound engine, which proved satisfactorily efficient.

The electric lighting of the city of Washington is under consideration, but the experiments hitherto carried out in the Pennsylvania Avenue have not, a correspondent of the *Times* states, been of a very satisfactory nature.

The Bonanza, a large warehouse just opened in Glasgow, is electrically lighted by incandescent lamps.

Telephonic Regulations.—At the meeting of the Associated Chambers of Commerce on Wednesday, last week, on the motion of Mr. Waytes (Leicester), a resolution was passed that all telephonic communication should be under Government control, with the view of a more complete and uniform system. Another resolution on the same subject, moved by Mr. T. Smith (Hull) and carried, was to the effect that it is desirable that the present excessive rates charged for telephonic communication be reduced, and that the Postmaster-General be requested to grant licences on such nominal terms and royalties to responsible persons or companies for the establishment of telephonic exchanges and trunk lines as will enable them to carry on such exchanges at the smallest cost to the public.

Long Distance Telephoning.—A series of experiments have been made between the Liverpool and Manchester offices of the Lancashire and Cheshire Telephonic Exchange Company, Limited, with the object of testing the practicability of sending telephonic messages a distance of 297 miles. The company has now its own wires laid from Liverpool to Manchester, *viâ* St. Helens, Wigan, and Bolton; and by a method of looping the nine wires which already run to Bolton, the distance mentioned was arrived at. The result of the experiments was said to be highly satisfactory. They were conducted by Mr. R. Heywood Claxton, manager of the Liverpool branch; and Mr. Charles Moseley, the chairman of the company at Manchester.

Underground Telephone Wires in Edinburgh.—The Streets and Buildings Committee of the Edinburgh Town Council had under consideration, at a meeting held last week, an application by the National Telephone Company, Limited, for permission to lay underground telephone wires in the city. After deliberation, the committee agreed to recommend that the council sanction, by way of experiment, the laying of two main lines—the one to extend from the head offices of the company in St. Andrew Square to the south end of the North Bridge, and the other from the same place, along Rose Street, to the neighbourhood of Charlotte Square. It is proposed that the wires shall be enclosed in metal pipes and laid at the depth of two feet from the surface of the streets, branch lines to be laid at various points on the route, where inspection boxes will be placed. As it is necessary to provide occasional means of communication between the underground pipes and the roofs of adjoining buildings for the purpose of establishing electrical connections with the offices of the company's subscribers, it is proposed to convey a cable of wires from the most conveniently situated box under the footpath to the wall of the building with which it is required to establish communication, and to carry the cable, enclosed in a pipe of small diameter, up the wall of the building to the roof. On the roof will be erected a standard of wood or iron, from which connection will extend to the offices of the subscribers.

New Telephone Company in America.—The Rochester Overland Telephone Company has been formed to conduct a general telegraph and telephone business within the county of Monroe, and beyond its limits, if required, with a capital of $250,000.

The Telephone Contest in America.—The suit between the Bell Telephone Company and the People's Telephone Company is now proceeding before Judge Wallace in the United States Circuit Court. The importance of the suit has given great prominence to it in legal as well as in business circles in America, as it involves the right to the possession of patents worth many millions of dollars. The first two days of the hearing and part of the third were taken up by the explanations and arguments of Mr. J. J. Storrow on behalf of the Bell Company. In discussing Drawbaugh's claim, Mr. Storrow said that it was a very singular fact that there were so many people living in the same village with Drawbaugh who did not know

that he had invented a talking machine or telephone. When asked to enumerate the inventions made by Daniel Drawbaugh, his brother gave a list of inventions, but the telephone was not among them. David Haupt, a well-known man in the village, hadn't heard that Drawbaugh ever invented a telephone. According to Drawbaugh's testimony he talked through his telephone with his sixteen-year-old daughter in 1864. When asked why he did not go to work and perfect his telephone and give it to the world, he replied that he was too poor to do it. Capital was necessary to build a shop for the manufacture of the instrument. Mr. Storrow claimed that this was not true, from the testimony of witnesses who had been placed on the stand by the defence. A company had been formed by citizens who believed in some of Mr. Drawbaugh's inventions, and a shop erected for their manufacture. With a capital of some $5,000 this company had gone into the manufacture and sale of a patent molasses faucet. Had Drawbaugh invented a telephone, would not the company have made all haste to put its capital into the manufacture and introduction of such a valuable invention? Commenting upon the evidence offered by the defence, counsel said, in relation to Mrs. Drawbaugh: "They have not dared to call her as a witness. They have called plenty of witnesses to testify to what they had heard Mrs. Drawbaugh say, but they have never put her on the stand to testify for herself, and yet she, of all others, must have known if Mr. Drawbaugh had invented any talking machine and the date of it." There was another significant thing, counsel urged, as showing that Drawbaugh had never invented a telephone, and that was that there was no sketch or drawing of anything of the kind preserved. Of the faucet improvement and the electric clock, &c., there were plenty of memoranda and drawings preserved, but not a scrap of paper to represent a talking machine, a far more important invention than any of the others. Mr. Storrow called attention to the different models of talking machines made by Drawbaugh, which were ranged in front of Judge Wallace, and to his assertion that these were made prior to 1876, and then commented on the testimony of witnesses who at that time were working in his shop, one of them living under Drawbaugh's own roof, who had testified that they never saw or heard of them and that their testimony showed that Drawbaugh was mistaken as to the dates. Henry C. Springer testified that he used to go down to Drawbaugh's shop to assist him in perfecting a talking machine, and that this was in April, 1876, two months after the Bell patent, and that the machine was the tumbler and the tin can; while it was admitted that all of the other machines were made after that one. In conclusion, Mr. Storrow said: "Do you want to know if Mr. Bell invented the telephone? Ask him. He will tell you, 'Look around you; every one is using them.' Ask Drawbaugh. He will say, 'No one ever used my telephone. I never used it myself, except for the purposes of experiment.' Your Honour will choose between them." After a recess Mr. L. Hill began the argument on the part of the defendant. He urged that if they showed an instrument that was capable of transmitting the human voice by means of a current of electricity, then that would cover all the points claimed for the Bell patent. It was not necessary that the instrument invented should be a speaking telephone as at present perfected. He then cited some cases where there had been inventions which had never been patented and in which the inventors had never applied for a patent, and yet the existence of which had been held to invalidate the patents obtained for similar inventions. The fact, therefore, that Mr. Drawbaugh had not patented his talking machines, or had not applied for a patent had nothing to do with this case. Mr. Hill then read the testimony of Mr. Bell as to the dawn of the principle of the telephone in his mind, and commenting on this he said that the instrument made by Bell in 1874 was entirely different from the speaking telephone, and was merely an instrument for analysis and synthesis of sounds. In all of Mr. Bell's statement there is nothing which avers that he transmitted articulate speech until March 20th, 1876, three days after he had filed his application for a patent.

The Telephone in Germany.—The number of towns in Germany provided with the telephone is 45, with a total of 7,549 subscribers. To every 1,000 inhabitants, Berlin has 17 subscribers; Mannheim, 21; Hamburg, 28; Frankfort, 25; and Stettin, 23. New subscriptions already announced will bring the number of subscribers up to 9,000 by the end of the year.

Breakage of Atlantic Cables.—During the week various statements have come to hand respecting the breakage of one, or both, of the Western Union, or Jay-Gould cables, and of the first Mackay-Bennett cable. It was first insinuated that icebergs had something to do with the severance; but this was afterwards discredited. Tests at Penzance showed that the cables were broken about 1,800 miles from the Land's-End. Taking the route of the Jay-Gould cables, this distance would bring us just round the southern end, and to the westward, of the Great Newfoundland Bank, where the depth of water suddenly increases from some 150 fathoms to 1,450 fathoms. Here are five cables, all laid very close to the edge of the bank. These are the 1869, or French Atlantic cable; the 1879, or Pouyer-Quertier cable; the two Jay-Gould cables, 1881-82; and the first Mackay-Bennett cable. It seems highly probable that the real cause of the mischief is the *Faraday* herself. Perhaps she lost the second Mackay-Bennett cable, for she was reported as laying, notwithstanding bad weather and fogs; and trying to recover the end she possibly ran foul of and broke the other cables. The correspondent of the *Standard* at Penzance telegraphs that it has been ascertained that only one of the Western Union cables is actually broken; and the *Financial News* thinks it just possible that the report is a part of the scheme of the Gould party in New York to invite a short interest in the Gould stocks for the purpose of helping a projected bull movement.

Just as we are going to press we are informed, but without confirmation, that the Mackay-Bennett cable is still intact. The laying of the second cable is stated to have been completed on Wednesday by the *Faraday*.

Cable Repairs.—A vessel left Singapore on Thursday, the 2nd inst., in order to repair the cable between Saigon, Haiphong, and Hong-Kong.

Telegraphic Communication with Eddystone Lighthouse.—A deputation from the Plymouth Chamber of Commerce has had an interview with the Trinity Brethren, and urged the importance of establishing telegraphic communication with the new Eddystone Lighthouse. The chairman, Mr. Bellamy, said that it was proposed to form a small local company to lay the cable, which would then be worked by Lloyds' committee; the Trinity Brethren having full control over it, and being only required to consent to the scheme. The importance of the connection to vessels passing up and down channel was also pointed out. The Brethren promised to give the matter their earnest consideration.

The Posting of Telegrams.—Telegrams can now be posted in letter-boxes throughout Germany, although the circulation is solely restricted to the Empire itself. The message need simply be written on ordinary paper and endorsed "Telegram," and the tariff rate can either be attached in postage stamps or paid by the receiver.

The Egyptian Telegraphs.—The *Times* understands that the British military authorities took possession of the Nile telegraphs on Tuesday, the 30th ult., at noon. With a view to the better administration of the telegraph arrangements in Egypt, Her Majesty's Government has, at the nomination of the Postmaster-General, appointed Mr. A. Otway, one of the assistant-superintendents at the London Central Telegraph Office, to be superintendent of the telegraphs at Cairo.

Delaying Telegrams in Italy.—The *Times* correspondent at Rome telegraphed on October 2nd:—"The *Diritto* has given prominence to a protest against the system of delaying the delivery of Press telegrams. It complains that a despatch sent from Genoa at three o'clock p.m. to enable it to give to its readers the latest intelligence concerning the epidemic there, was not delivered at its office until 8.40, and after the paper had gone to press. The telegraph boy was not to blame, for the despatch was only consigned to him for delivery at 8.30. That five hours and 40 minutes should be required for a telegram from Genoa to reach Rome the *Diritto* thinks somewhat excessive, and it draws attention to the fact because, it says, 'We should regret to see those delays renewed with regard to Genoa which our telegrams from Naples have already been subject to, and we hope that the directors of the telegraph office will take measures to prevent similar inconveniences to ourselves and others.' Nothing could be more exquisitely polite and deferential than the manner in which this remonstrance is addressed *pro formâ* to the directors of the telegraph office, who have nothing to do but to await and obey the orders of that parental censorship of Press telegrams both arriving and leaving, foreign as well as home, applied so recently to myself and to the correspondents of two of your contemporaries."

The Soudan Telegraphs.—A Reuter's telegram from Cairo announces that telegraphic communication above Assiout is interrupted.

Supervision of Press Telegrams in Egypt.—The *Times* correspondent at Dongola, telegraphing on October 8th, says:—"On behalf of my fellow-correspondents and myself I desire to state that all our telegrams from or to England are subjected to a military *visé*, here and at Wady Halfa, before delivery to the addressee. The existing arrangement renders telegraphing practically valueless and wasteful."

Canadian Government Telegraphs.—It is understood that Mr. F. N. Gisborne, the Superintendent of the Government telegraphs of Canada, is about to leave Ottawa for British Columbia for the purpose of investigating telegraph matters in the Pacific Province, so that, as far as possible, telegraph construction may keep pace with the rapid building of the Canadian Pacific Railway.

The Nile Expedition.—The first detachment of the Telegraph Corps, with other troops, arrived at Wady Halfa on Saturday last.

The American Association.—The attendance at the Philadelphia meeting of the American Association, 1,249 in all, included 303 members from Great Britain. This was a larger contribution than that of any state in the union, even New York, which sent 161 members. Pennsylvania, of course, had a comparatively large representation, 246. The new members elected numbered 515, the membership up to the time of the meeting being 2,033. Altogether the meeting was credited with being the most successful yet held. The electrical conference added to the interest of the occasion, but some thought there was too much on the programme to be accomplished satisfactorily, and yet leave time for recreation and the enjoyment of hospitalities.

Technical Education in Board Schools.—The Rev. Thomas Morse had on the agenda paper of the London School Board a notice of motion to be made on Thursday, advocating the establishment of a central school for the more thorough instruction of scholars in the upper standards, and for carrying on the education of those who may be intended for technical work and industrial employment. The motion contains suggestions for the provision of a chemical laboratory, for instruction, both of boys and girls, in the elements of magnetism and electricity.

The Dangers of Electric Lighting.—Mr. R. E. Crompton, referring to the recent fatal accident to an attendant on a dynamo machine at the Health Exhibition, points out in the *Times* that currents of extremely high electromotive force, such as that which caused the accident, have never been, and can never be, used for electric lighting in the form of the incandescence lamp, which is the only form suitable for domestic use. He says his intimate connection with electric lighting has rendered it necessary for him to obtain exact data as to the extreme safe electromotive force or electrical pressure which can be safely used in situations accessible to the touch of human beings or animals. He had never been able to trace any accident to life or even injury to health from contact with electric wires, provided that the electromotive force had not exceeded 600 volts. The object of using such high pressures is to economise the weight and cost of conductors when the lamps are scattered over a wide area; but at the Health Exhibition there was no such necessity for economy, and it was much to be regretted that those responsible for the scientific management of the Exhibition should have allowed such dangerous pressures to be used in such a crowded and unprotected situation. He further stated that so long as currents of low electrical pressure (such as are used with incandescence lamps) pass through the wires, they may be safely touched with one or both hands by a young child or delicate person with absolute impunity, and with no disagreeable sensation beyond a slight pricking if the hands are damp.

Mr. George Freemantle, Secretary of the Manchester and District Edison Electric Light Company, Limited, 19, Victoria Buildings, Manchester, writes to the *Manchester Guardian*:—"The recent death of an electrician at the Health Exhibition while oiling a dynamo machine has doubtless caused alarm to some who think of adopting the electric light in their houses. The circumstances of the case have not been clearly given in any of the public papers. I think it right, therefore, that it should be stated that in incandescent lighting there is not the slightest danger, and little inconvenience experienced from handling the naked terminals of a machine driving a circuit of Edison lamps; and as the resistance of the Edison lamp is higher than any other form of incandescent lamp, it follows that the inconvenience is still less when lamps of the Swan type are used. What I have said may be put to the test by any one who will visit this company's central station in Mount Street. Here the current for lighting the Theatre Royal is generated, and any one who comes to do so may handle the terminals of the powerful dynamo machines employed without suffering more than a slightly uncomfortable feeling such as is usually experienced when receiving a 'shock' from an ordinary electrical machine."

Brighton Electric Railway.—The extension of this line having now been in active operation for six months, a few particulars may be interesting as showing the capabilities of a light line of this description. The details of construction have been already described in our columns, and need not, therefore, be repeated. The car mileage amounts to 15,600 miles, or 100 miles per diem. The number of passengers, in round figures, 200,000. This number would have been larger, but for the fact that at certain hours the would-be passengers exceeded the capabilities of the car, which only seats 30 persons. No accident has occurred to either the general public or to passengers by the car. The consumption of gas in the gas-engine has been 300,000 cubic feet, or 1½ cubic feet per passenger per mile. The total cost of traction, including interest and depreciation on engine, dynamo, and motor, cost of gas, oil, and attendance, has amounted during that period to 15s. 6d. per day (100 miles run), say 2d. per mile. The car service has only been stopped for one day, through the tires of the wheels giving out owing to the heavy pressure of the holiday traffic, at the time there being no second car available.

Electric Railways in the States.—The *American Journal of Railway Appliances* contains an article on a new electric railway at Coney Island. Running along the west side of the new iron pier at West Brighton, a track 780 feet long, nearly the whole length of the pier, has been laid. The gauge is 24 inches. The rails are of T section, 8 lbs. to the yard, and 20 feet long each. The ends of the rails are laid on a specially-made plate, clamps are then put on, and the whole firmly bolted together. To help the conductivity at the joints, these chairs have been reinforced with strips of copper. The rails themselves are laid on strips of wood, and both firmly bolted to the pier planking. No attempt is made at insulation. In fact, none is needed. The generator is capable of producing a 6 horse-power current. It is shunt-wound, with low electromotive force, and its normal speed is 1,100 turns per minute; its weight about 650 lbs. It is driven by one of the New York Steam Safety Power Company's 8-horse vertical engines. The motor is modelled after its famous predecessor, the Ampère, which ran so successfully last winter at Saratoga Springs. The body is made of 2 inch ash, is 6 feet 6 inches long, and 3 feet wide. The superstructure consists of only a dash-board 20 inches high, to which are attached the switches for controlling the motor; a box on the rear, 30 inches wide, 36 inches long, and 15½ inches deep, in which is placed the receiving dynamo, and in front of this box, and attached to it, the driver's seat. On the right of this seat is the reversing lever for reversing the brushes on the commutators, and giving either a forward or a backward motion to the motor. The running gear is simply four 12 inch wheels, with 4 inch centres, firmly attached to the body, and rigidly held in their place. To prevent short circuiting from rail to rail, *i.e.*, from one side to the other, the wheels on one side are specially constructed. An iron flange and an iron hub are firmly bolted to a solid, heavy piece of red oak. The wood effectually stops the tendency of the current to pass from one wheel to its opposite through the axle. The receiver is capable of giving from 3 to 4 horse-power. It is compound, and the best armature speed is about 1,500. The passenger service consists of two cars. They are substantially built, are 12 feet 2 inches long, 32 inches wide, and seat 20 persons each, 10 on a side, sitting back to back. This makes a total of 40 persons carried comfortably. As many as 50 have been carried; nearly 4 tons in weight. The cars weigh about 400 lbs. each. This season will give the Daft system a thorough test as regards safety, durability, and trustworthiness. Tests will be made upon which to base economical questions. It undoubtedly will prove itself fully capable, and will succeed in demonstrating beyond cavil its practicability.

An Electrician's Log Book.—We have received a copy of a log book, compiled by Mr. Wilfrid H. Fleming, for the use of electricians in charge of electric lighting installations on board ship. The book will doubtless be found useful, although we are inclined to think that electricians prefer to arrange their own tables. We do not find in Mr. Fleming's compilation any columns left for electrical indications or lamp breakages; perhaps he thinks these to be unnecessary. For those who make use of log books we may mention that the publishers of Mr. Fleming's production are Messrs. Dunsford & Son, South Castle Street, Liverpool.

Obituary.—The death is announced from Bangkok of Mr. Henry Alabaster, the most eminent European servant of the Siamese Government. Besides various political services, Mr. Alabaster, who had been at one time in the British Consular Service, played an important part in the great advances recently made by Siam. He introduced and established the telegraph and telephone in the country, collected a valuable European library for the palace, and originated the museum and botanic gardens at Bangkok. He was also the author of an important work on Buddhism, entitled "The Wheel of the Law."

The Electric Lighting Act.—At a recent meeting of the Dynamicable Society it was resolved to form a committee, including the names of most of the prominent electricians of the day, to draw up a report setting forth the errors in the evidence given by the "expert" witnesses before the Parliamentary Committee upon electric lighting in 1882; and to organise a movement for the repeal of the impossible clauses in the Electric Lighting Act of that year.

Mining Institute of Scotland.—At the meeting of this Institute in Glasgow, last week, Mr. Ralph Moore, Inspector of Mines, read a paper "On the occurrence of a flash of lightning passing down a shaft and into the workings of Swinhill Colliery, Stonehouse." The incident occurred on the 12th August last. While six women were sitting in a dock some of them heard a crack near the engine, and on looking in the direction saw a flash of light not so large as a lamp. At the same moment two of them were pitched forward, while two others were thrown over on them. Rushing to the pit bottom they heard thunder, and concluded that what they had seen was lightning. No damage was done to the pit. In the discussion it was remarked that, while such a noise was often heard, it had rarely been so well authenticated, and it was thought it might throw light as to the cause of some of the great explosions in the past.

Cardew's System of Dynamo-Winding. — Messrs. Latimer Clark, Muirhead & Company, Limited, are prepared to supply dynamos wound on a system patented and devised by Captain P. Cardew, R.E., Chatham, and to grant licenses for the use of this system. The invention consists in an arrangement to enable the same dynamo to be used for working arc, incandescence, or search lights at will. It is also possible to work arc and incandescence lamps in parallel simultaneously. The system is peculiarly applicable to differentially wound lamps. No artificial resistance is required in the circuit of the arc lamps to ensure perfectly steady burning and complete independence of action in the lamps.

A Feat in Telegraphy.—A Washington letter in the Boston *Globe* says:—"The special telegraphic report of the proceedings of the two last National Conventions were unprecedented for their accuracy and completeness. For the four days of the Republican Convention 1,660,178 words were telegraphed special through one of the companies—an average of 415,000 words a day. During the four days of the Democratic Convention 1,522,960 words were telegraphed special, or an average of over 380,000 per day. A competing line, which also did excellent service at the Conventions, sent about 70,000 words a day, and the other companies probably sent an amount equal to that. It is safe to assume that over 4,000,000 words of specials were telegraphed from Chicago during the eight days that both Conventions were in session. Hundreds of thousands of words were telegraphed the few days preceding the assemblage of each of the Conventions, and the revenues from specials to the telegraph companies during both Convention weeks at the Chicago offices could not have been less than 50,000 dollars."

Nottingham Post Office.—A new storey, for the use of the telegraph staff, is in course of construction for the Nottingham Post Office.

Tramway Experiment.—The Edinburgh Tramway Company applied to the Town Council for permission to make an experimental application of electricity to the propulsion of tramway cars. Arrangements had been made, it was stated, with Mr. Binko, for the electric railway now in operation at the International Forestry Exhibition, to apply his system to the tram cars. The section on which the trial was intended to be made was that from Coltbridge to the General Post Office, a distance of nearly two miles. No objection was raised to the trial by the council.

Fire at Telegraph Works.—On Tuesday night a fire occurred at the works of Messrs. Siemens and Company, telegraph engineers, Harrington Road, Woolwich. The outbreak originated in one of the experiment rooms, to which it was confined, no great amount of damage being sustained.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pilsen-Joel and General Electric Light Company, Limited and Reduced.—The annual return of this company, made up to the 26th ult., was filed on the 1st inst. The nominal capital is £200,000 in £5 shares. The shares taken up are 28,000 with £3 5s. paid, and 12,000 with £5 paid up. The calls paid amount to £85,892 18s. 4d., and unpaid to £5,107 1s. 8d., and the sum of £60,000 is taken as paid. As compared with the previous return the paid up capital shows an increase of £23,377 8s. 4d., and the amount considered as paid, an increase of £2,650.

CITY NOTES, REPORTS, MEETINGS, &c.

Great Western Electric Light and Power Company, Limited.

THE second ordinary general meeting of the shareholders of this company was held at the Cannon Street Hotel on Monday, when Mr. J. B. Braithwaite, jun., presided.

The directors' report was given in last week's REVIEW.

The notice convening the meeting having been read, and the minutes of the previous meeting confirmed,

The Chairman said the report had set before them in very clear language what the progress of the company had been during the past year. For the directors, the two main things had been, firstly, the reduction of the expenses of the company, which had now been established on a firm and satisfactory commercial basis; and in the second place, the development of a profitable business. They had reduced the expenses very considerably, and with regard to the receipts, he was glad to be able to say that they had almost trebled, as far as the lighting stations were concerned. Other business undertaken had been very limited in amount; a large amount of business had been offering, but not at rates which they could accept. A number of companies had undertaken installations at very low rates, for the purposes of advertisement, at considerable loss, and, in some cases, had even supplied the light for nothing; so that the public had got the idea that the electric light cost very little to produce. Now, however, they were being rapidly undeceived on that point, and the result was that there were inquiries for the light of a much more substantial character. Having explained that the delay in calling the meeting had been occasioned by the assent of the Court having only been given to the reduction of capital on August 6th, the liability on the shares, therefore, not ceasing till September 6th, the Chairman referred to the claim of the liquidators of the Devon and Cornwall Electric Light Company. They, he said, very properly made a claim amounting to a very large sum for a large amount of the purchase-money, for the whole of the sum sunk in plant, and for a considerable portion of the amount expended in working the Devon and Cornwall Company. This had been the source of a great deal of anxiety to the directors, but he was glad to be able to announce that they had arrived at a fair and equitable settlement for both sides, being the surrender of the fully-paid shares held by this company in the Devon and Cornwall Company, and the issue to the liquidators of the latter of 3,000 fully-paid shares of £2 10s. each in the Great Western Company. The result of this settlement was that the claim of the liquidators of the Devon and Cornwall Company was withdrawn, and the reduction of the capital of this company was proceeded with; and it also had the further effect of restoring to the shareholders the whole of their property, which was not their own until the claim was got rid of. Now, for the first time, they stood clear from litigation of every kind, and free to go forward with business. The lighting stations were, of course, a bequest of the late board; but they were doing their best to develop them into something of a profit to the company. Considerable money was locked up in the plant at those stations. Last year they succeeded in a large reduction of expenditure, and an increase of something like 200 per cent. in the receipts; that increase, he was happy to say, was going forward, and they had received a considerable number of new orders for lighting from the stations. They hoped next year to bring about an equilibrium of receipts and expenditure. They had purchased a portable plant, which he thought would be of great service. There was nothing like a supply to create a demand, and with the expenditure of a small amount of money they had a plant which could be sent to any part of the district to bazaars, flower shows, athletic sports, and the like. It paid for itself, and besides, it made the company and the light well-known throughout the district. They had taken steps to canvass one or two likely towns, with a view to testing their suitability for erecting lighting stations, but up to the present no town had given sufficient promise to warrant their erecting any plant. With regard to the Anglo-American Brush Corporation, negociations had taken place with the result that, in exchange for the right to light railways trains in this company's district, and to put up plant for that purpose, the Brush Company surrendered £5,750 in fully-paid shares in this company, thus reducing the capital by that amount. With regard to the future, they trusted, by exercising prudence and economy, to carry on the company at a small outlay—that was looking at it from the worst point of view. There was some hope, he thought, of a small profit. They had the company established on a sound basis, and the question was now whether any business could be obtained to return a profit. There were signs that electric lighting was coming to the front; nearly every new building erected was either lit by the electric light, or provision was made for its introduction, as in the new Council Chamber of this city. Unfortunately, they had made a cash loss of £537 19s. 11d. on the trade account; in addition to which there was a paper loss, by depreciation, of £529 5s. 3d., the total loss for the year, therefore, being £1,067 5s. 2d. The chairman then moved the adoption of the report and accounts.

Mr. C. H. Stewart, a director, in seconding the motion, said he could confirm all the chairman had said as to the difficulties which had been encountered during the past year in opposing the Devon and Cornwall Company. They told the solicitors of that company plainly that they should take proceedings against them, whereupon they reduced their accounts by £500. He need not say that the complications had arisen through the action of the old board, for they were all perfectly well aware of it. He was happy now to advise them that all those complications were closed, and they were in a position to go on with the business, if there was a business to obtain. It was a question whether the public would take to the electric light sufficiently to make the business profitable; but if they followed in the footsteps of the Americans that would not be long in doubt, because in almost every town in the States the electric light was used, and, he believed, very many of the mines were similarly lighted. He believed that if it had not been for the unjust legislation of the Government, which seemed to him entirely in the interests of the gas companies, much more progress would have been made. But he looked to the justice of Parliament to rectify that mistake, and to give a fair chance in the future to the electric light.

Mr. Brooker said while they had a little money they had better divide it. It was all nonsense about going on. The directors knew it was no good. They had been swindled by the former board, and now that they had honest men for directors the money ought to be divided. He was quite certain in his own mind that the directors knew the company would not pay.

The Chairman, having explained some matters of account, respecting which questions were asked, said he was rather surprised to hear Mr. Brooker in one breath say that the present directors were honest men, and in the next that they were well aware the company would not pay. The moment they came to the conclusion that there was no prospect of the company paying they would urge upon the shareholders to wind up.

The motion for the adoption of the report was then put and carried.

Mr. Offor moved the re-election of Mr. Braithwaite as a director. He said only those who were personally and actively engaged in developing the electric lighting industry could know what the difficulties were in the way of success. He (the speaker) could fully endorse the remarks of the chairman as to the prospects of the light in the future, and in the immediate future. Those who studied the technical journals dealing with electric lighting, and watched from week to week the business now being effected upon profitable terms, would thoroughly agree with him when he said they were in a much better position now than 12 months ago. There had been difficulties in consequence of the Electric Lighting Act, no doubt; but there had been other difficulties—the partners in electric lighting businesses had been proclaiming to the world that their business was a failure. This was a great mistake. They were partners, and should do their utmost to inspire confidence on the part of the public.

Mr. Ladd seconded Mr. Braithwaite's re-election, and also testified that electric lighting was on the increase.

The motion was carried unanimously.

The auditors, Messrs. Turquand, Youngs & Co., were re-elected. A vote of thanks having been passed to the board, the meeting terminated.

The Eastern Extension, Australasia, and China Telegraph Company, Limited.

THE following report of the directors for the six months ended 30th June, 1884, is to be presented at a meeting to be held on Wednesday, the 15th inst.:—

The gross receipts, inclusive of Government subsidies, have amounted during the half-year to £237,672 11s. 5d., against £213,729 4s. 5d. for the corresponding period of 1883, showing an increase of £23,943 7s. 0d.

The working and other expenses (including £22,784 5s. 9d. for cost of repairs and laying of new cables and expenses of ships) absorb £66,658 18s. 9d., against £62,778 11s. 7d. for the corresponding half-year of 1883, leaving a balance of £171,013 12s. 8d. From this is deducted £2,002 17s. 0d. for income tax, and £41,595

for interest on debentures and contributions to sinking funds, leaving £127,415 15s. 8d. as the net profit for the half-year, against £107,356 2s. 1d. for the corresponding period of 1883. Against this the directors have charged £22,767 17s. 7d. for the partial renewal of the Java-Australian (original) cable, which is referred to below.

One quarterly interim dividend of 1¼ per cent., amounting to £31,250, has been paid during the half-year, and it is now proposed to distribute another of like amount, together with a bonus of 2s. per share, payable on the 15th instant, making a total payment of 3¼ per cent. for the half-year, leaving £17,147 18s. 1d. to be carried forward.

In accordance with the provisions of the trust deed dated 10th May, 1879, 909 five per cent. Australian Government subsidy debentures were drawn on the 23rd April last for payment at par on the 1st July. Up to date 654 debentures have been presented, and paid off by the trustees.

During the half-year under review the policy of strengthening the company's system by judicious extensions, and the renewal of those portions of the cables exposed to damage from the teredo has been continued.

The cable between Tonquin and Hong Kong, to which reference was made in the last report, has been successfully laid by the company's ss. *Sherard Osborn*, and opened for traffic. The cost of the same, and of the cable between Cape St. James, Thuan-an, and Tonquin, is shown in the capital account.

The cable between Hong-Kong and Macao has also been completed and opened for traffic. The cost of this will appear in the current half-year's accounts.

It will be satisfactory to the shareholders to learn that during a recent short interruption of the direct Hong-Kong-Cape St. James cable, the whole of the China traffic was transmitted *vid* Tonquin without any appreciable delay, thus showing that the new cables give the company a valuable alternative route between Cochin-China and China.

The operation of picking up the old cable on the Sahul Bank, which has been renewed by brass-ribboned cable, as stated in the last report, was attended with considerable success, 394 knots being recovered out of a total length of 404 knots. This cable has been taken into the spare cable account at a moderate valuation, and when it has been overhauled and re-served on board the company's hulk at Singapore will be available for renewals or extensions in other directions as required. By these means the cost of the renewal is reduced to £22,767 17s. 7d., which has been met, as shown in the accounts, without any addition to capital expenditure.

The threatened opposition line *vid* Tavoy, which was likewise referred to in the last report, has been closed for several months past, owing to excessive mortality amongst the staff employed, and to difficulties of maintenance during the rainy season. It is, however, expected to be re-opened during next month.

Several cable interruptions have occurred at various points of the system which have given the repairing ships full employment during the half-year. The traffic, however, has been transmitted by the duplicate lines.

All the company's cables, with the exception of the Saigon-Hong-Kong and Hong-Kong-Tonquin sections, which are expected to be repaired in a few days, are in good working order.

The Government land line between Port Darwin and Adelaide has been well maintained by the South Australian Government during the half-year.

United Telephone Company of the River Plate, Limited.

THE report of this company for the year ended March 31st last, states that the capital expenditure in extending the exchange and private wire systems in Buenos Ayres up to March 31st, 1884, has been £22,015, of which £8,046 was on account of extensions from October 15th, 1882, to March 31st, 1883. The revenue from subscribers and profits on sales for the year ending March 31st, 1884, was £19,533. The working expenses of the year in Buenos Ayres have been £12,445. The progress of the business has been very gratifying. The revenue from subscribers for the three months preceding the date at which the business in Buenos Ayres came under the management of the company, April 1st, 1883, was £1,600, and for the corresponding months in 1884, £4,037. For the six months ended June 30th, 1884, the revenue from subscribers and profit on sales was over £14,000. The reliably paying subscribers in March, 1883, were but a little over 300. Latest reports from Buenos Ayres show that the list of subscribers now exceeds 1,300. Since March 31st, 1884, the debt of the company has been reduced over 3,000. Preliminary and London expenses have been placed to the debit of revenue account, leaving a net revenue of £4,075, from which it is proposed to write off £3,500, being 5 per cent. of total expenditure on plant, for depreciation, carrying forward a balance of £575.

Anglo-American Telegraph Company, Limited.—At a meeting of the board of directors of this company, held on the 3rd inst., it was resolved, after placing the quarterly sum of £37,500 to the renewal fund, to declare an interim dividend for the quarter ending 30th September, 1884, of 15s. per cent. on the ordinary stock and 30s. per cent. on the preferred stock, payable on the 1st November to the stockholders registered on the books of the company on the 30th September.

Western Union Telegraph Company, Limited.—A meeting of the Western Union Telegraph Company on Wednesday approved the recommendation of the president that the dividends in future shall be at the rate of 6 per cent. yearly. One more quarterly dividend of 1½ per cent. will be paid in October, and the next dividend of 1½ per cent. will be paid in January. The Manitoba dividend will also be reduced to 6 per cent.

The Eastern Telegraph Company, Limited.—This Company announces a dividend of 3s. per share on the preference shares, less income-tax, for the quarter ended September 30th, and an interim dividend of 2s. 6d. per share on the ordinary shares, free of income-tax, in respect of profits for the quarter ended June 30th last, payable on the 15th inst.

Mediterranean Extension Telegraph.—In Liquidation.—The office of this company has been transferred to the office of Mr. J. G. Griffiths, the liquidator, of the firm of Deloitte, Griffiths & Co., of No. 4, Lothbury, E.C.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations Oct. 9.	Business Done.
		ELECTRIC LIGHT.			
40,000	5	Anglo-American Brush Co.	5	1½ - 1⅞	
		Do. Do.	5	2½ - 3⅛	
30,000	5	Australasian E. L., Power & Storage Co.	4	..	
24,900	10	British Insulite Co., Ld., "A" Shares..	6	..	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅜ - ½	
47,233	5	Hammond Elec. Lt. & Power Sply. Co.	5	½ - ⅝	
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2½	..	
250,000	½	Maxim-Weston Elec. Lt. & Power Co. ..	½	½ - ⅝	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	3½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.	5	..	
		TELEGRAPHS.			
1,892,480*l.*	Stk.	Anglo-American, Limited	100	32½ - 33½	34¼, 3½, 4
2,553,760*l.*	Stk.	Do. Pref. { Def. receiving no div. until	100	56½ - 57½	57¼, ½, ¾, 1, 1¼
2,553,760*l.*	Stk.	Do. Def. { 6 p. c. paid to Pref.	100	7 - 7⅛	7⅛
130,000	10	Brazilian Submarine, Limited	10	11¼ - 11½	11⅜, ½
150,000*l.*	100	Do. 5 per cent. Bonds	100	102 -104	
16,000	10	Cuba, Limited	10	11 - 11½	
6,000	10	Do. 10 per cent. Preference ..	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	3½ - 4	
6,000	10	Do. 10 per cent. Preference	10	15 - 15½	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	10 - 10½	
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	98 -102	
380,000	10	Eastern, Limited	10	11¼ - 11⅜	11⅛
70,000	10	Do. 6 per cent. Preference	10	15⅜ - 15⅝	15⅜
200,000*l.*	100	Do. 5 do. Debs., repayable Aug. 1887	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104 -107	
500,000	Stk.	Do. 4 do. Debenture Stock	100	99 -100	
250,000	10	Eastern Exten., Australasia & China, L.	10	12⅛ - 12⅜	12⅛, ¼, ⅜
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	109 - 112	
640,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	103 - 106	103¼
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 - 105	
550,000*l.*	{ 100	{ Eastern & South African, Ld., 5 p. c. { Mort. Deb. Rg. redeemable 1 Jan. 1900 {	100	103 - 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	9⅞ - 10⅛	
250,000	10	Globe Telegraph & Trust, Ld.	10	7 - 7⅛	7⅛, 3/16, ¼, 5/16, ⅜
250,000	10	Do. 6 per cent. Preference	10	12⅜ - 12⅝	12⅜, 7/16, ½
150,000	10	Great Northern	10	15½ - 15⅝	
100,000*l.*	100	Do. 5 per cent. Debentures ..	100	101 -104	
300,000*l.*	100	Do. 5 per cent. Debentures ..	100	102 -105	
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	23 - 24	
100,000	100	Do. 6 per cent. Debs., 1886	100	101 -103	
18,000	25	Indo-European, Limited	25	32 - 33	
40,000	10	London Platino-Brazilian, Limited	10	4 - 4½	
100,000	100	Do. 6 per cent. Debentures ..	100	101 -103	102
10,000	8	Reuter's, Limited	8	8 - 8½	
338,225*l.*	Stk.	Submarine	100	179 -180	
75,000	1	Do. Scrip	1	1⅛ - 1⅜	
4,200	Cert.	Submarine Cables Trust	100	102 -105	
37,350	12	Telegraph Construction and Mainten.	12	34 - 35½	
150,000	100	Do. 6 per cent. Bonds, 1889	100	106 -109	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅛ - 1⅜	
30,000	10	West Coast of America, Limited	10	5⅞ - 6⅛	
150,000*l.*	100	Do. 8 per cent. Debs.	100	110 -113	
45,181	15	Western and Brazilian, Limited ..	15	6⅞ - 7⅛	
24,729	7½	Do. Preferred	7½	4⅜ - 4⅝	
24,729	7½	Do. Deferred	7½	2⅛ - 2⅜	
200,000*l.*	100	Do. 6 p. c. Debs. "A" 1910	100	102 -104	
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	98 -100	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	123 -125	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	⅝ - 1⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	7⅛ - 8	
4,669	10	Do. 6 do. 2nd do. ..	10	4⅛ - 5½	
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,163	1	7/16 - 9/16	
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	½	¼ - ⅜	
100,000	5	United Telephone Co.	5	13½ - 13⅝	13½, ¾
20,000	5	Do. New, issued at £2 pm.	2	7⅛ - 8⅛	8, 7/16

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th September, are £1,987 as compared with £2,259 in the corresponding period of 1883. The June receipts, estimated at £6,066, realised £6,196.

The Great Northern Telegraph Company. The receipts for September, 1884, £26,000; and from 1st January to 30th September, 1884, £208,680; for the corresponding months of 1883, £191,877; and for 1882, £182,294.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of September, 1884, were £1,619, against £1,710 in the corresponding period of last year.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 3rd, were £2,779, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

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CORRESPONDENCE.

Bell's Telephone Patent—The English Mechanic—The Glasgow Receiver—The Goldbeaters' Skin.

Your correspondent, "S.," in his letter published in the REVIEW of 4th inst., writes, "'W. C. B.' is not correct in saying that Bell's telephone was described in *Engineering* prior to the patent being applied for in this country." I take leave to assert that that statement was correct. I have not before me *Engineering* of September, 1876, but I quote the following lines from the report of the case of the U. T. Co. *v.* McLean in Edinburgh, to be found on page 66 of ELECTRICAL REVIEW of January 20, 1882:—"On or about September 7, 1876, Sir William Thomson, in his address to Section A of the British Association at Glasgow, exhibited and described actual specimens of both parts of the said alleged invention, and 'the said alleged invention was described in the British journal called *Engineering*, on 15th September, 1876,' and detailed drawings of the instruments of the said invention were afterwards published in the same journal on 22nd December, 1876."

I refer "S." to Morgan Brown's (Bell's) patent, December 9, 1876, for the proof that the receiver called the English mechanic, which "comprises the combination of a parchment diaphragm with central iron button and an electro-magnet," is *not* mentioned in the specifications, nor shown in the drawings; this instrument, therefore, was not included in the patent, and the "disclaimer of 13th February, 1878," referred to the instrument exhibited in figure 19, and is described thus:—"The armature, A, is fastened loosely by one extremity to the uncovered leg of the electro-magnet, E, and its other extremity is attached to the centre of a stretched membrane, *n*."

This instrument is an entirely different one from that described in the *English Mechanic*.

Your correspondent, "S. R.," in his letter published in the REVIEW of 20th September, page 220, writes:—"The 'Mechanic Receiver' is so called because it was described in the *English Mechanic* for August 11, 1876—the first definite intimation in England of the great discovery of Bell." I take leave to say that the first definite intimation in England of what "S. R." is pleased to call "the great discovery of Bell" was published many months before that date.

The "Proceedings of the American Academy of Arts and Sciences," vol. xii., pp. 1 and 7, contains a detailed account given by Mr. Bell, May 10th, 1876, of his researches in telegraphy to that date. I quote from that publication the following description:—"Two single-pole electro-magnets, each having a resistance of 10 ohms, were arranged upon a circuit with a battery of five carbon elements. Drumheads of goldbeaters' skin, seven centimetres in diameter, were placed in front of each electro-magnet, and a circular piece of clock spring, one centimetre in diameter, was glued to the middle of each membrane." This book was received at the Patent Office Library and other public institutions. Further, on September 9, 1876 (vol. xxxv., page 162), the *Scientific American*, a journal very largely circulated in this country, published an article entitled, "The Human Voice Transmitted by Telegraph," in which the said invention was described, as also in the following journals circulating in England, and four of which have offices in London:—*New York Herald*, *Tribune*, *Daily Graphic*, *Boston Advertiser*, *Chicago Times*, the *Toronto Globe*.

In the specification of Morgan Brown's (Bell's) patent, December 9, 1876, 4th edition, page 17, lines, 42, 43, 44, will be found the following description of Bell's instrument:—"The armature, A, figure 19, is fastened loosely by one extremity to the uncovered leg, *h*, of the electro-magnet, E^1, and its other extremity is attached to the centre of a stretched membrane, *n*."

This is the instrument which was the subject matter of the disclaimer of 13th February, 1878, in these words:—"No claim is made to the use of telephonic apparatus, wherein a membrane like goldbeaters' skin is used in combination with an electro-magnet—as such a membrane was mentioned in descriptions published in England prior to December 9, 1876."

The United States Official Gazette of Patents, dated March 7, 1876, which contained a description and drawing of this instrument, was on public view at the British Patent Office on 3rd July, 1876, and this prior publication necessitated the disclaimer of 13th February, 1878.

The publications above referred to establish the following facts in regard to Bell's inventions:—

1. Bell's United States Patent of February 14th, 1876, which described an instrument to be used as a transmitter and receiver, viz., "one end of an armature attached to the centre of a stretched membrane," was published in England on 3rd July, 1876; in the U.S. Official Gazette of Patents, dated 7th March, 1876.

2. Morgan Brown (Bell's) English patent of December 9th, 1876, included the above-described instrument; and as it had been published prior to that date, Brown filed a disclaimer on 13th February, 1878. The words of the disclaimer are as follows:—"Whereas it has been ascertained that parts of the said invention, as described in the said specification, were not new in the United Kingdom at the date of said Letters Patent, by reason of descriptions thereof having been published in England before the 9th December, 1876, I am desirous for the above reason of amending my said specification, and of confining the claims in the said specification to arrangements of telephonic apparatus, wherein are employed plate armatures or armatures other than those carried by a membrane, and arrangements wherein are employed permanent magnets or magnets excited by batteries which are not in the main circuit or line wire." "For the reasons aforesaid, it is to be noted that no claim is made to the use of telephonic apparatus wherein a membrane like gold beater's-skin is used in combination with an electro-magnet, &c., &c."

Therefore, that instrument is public property.

3. The instrument commonly called the "English Mechanic," being the combination of a membraneous diaphragm with a piece of watch-spring attached to its centre, was exhibited by Sir William Thomson with the Glasgow receiver, viz., "the iron disc cocked up," and was not included in the patent of December 9th, 1876, and was published in this country on 11th August, 1876, in the *English Mechanic*, and in ELECTRICAL REVIEW of October 1st, 1876, page 257, and also in other publications prior to that date, and therefore it is public property.

4. The instrument known as the Glasgow receiver was not included in the patent, and has been decided by the Court of Appeal to be public property, in consequence of its having been exhibited publicly by Sir William Thomson, and having been described in the ELECTRICAL REVIEW in page 257, October 1st, 1876, prior to the date of said patent.

The above references establish the fact that the above-described instruments are not covered by Morgan Brown (Bell's) patent of December 9th, 1876, and the Master of the Rolls, the late Sir George Jessel, in the judgment of the Court of Appeal, described Bell's invention "as a thin plate or disc in front of the magnet, close to the magnet, separate from the magnet, fixed or attached in such a way as to keep the whole circumference fixed."

W. C. Barney.

October 6th, 1884.

Electrical Energy Recorder.

Your correspondent, "Volta," in his anxiety to establish his fancied prior claim to my energy recorder, has evidently rushed into print with but a vague idea of what he is writing about. The instrument he made, and which he describes as being "precisely similar in *almost* every respect, &c.," as a current meter to that patented by me, was, apparently, according to his own showing, not an energy recorder at all; neither was that of the "same kind" that he made in 1883. It is a great pity that "Volta" did not make my combined instrument in 1880, for had he done so I should have been obliged to concede the priority of the invention to him, but since that is not the case, I trust that you will allow me this opportunity of putting the plain facts before you, in support of my just claims.

In May, 1882, I constructed an energy recorder, not *almost*, but exactly similar in principle to that described in your issue of 29th inst., and used the same for measuring the energy absorbed in the circuit of some large primary cells I was then experimenting upon. The only difference in actual construction was, that the paper was a continuous strip reeled from an auxiliary drum; the latter being driven by clockwork. I found that the levers in that case required to be of extreme length; but in my recently patented instrument, described in your issue of 29th ult., I have found suitable means for remedying this defect without the unnecessary complication caused by the use of multiple levers.

The original instrument to which I have referred above, was constructed at the Basted Paper Mills, where I was chief engineer at the time; and, should it prove necessary, I can produce the proper vouchers for the accuracy of my statements. I may add that I obtained the idea from the steam engine indicator; and do not think that, at that period, I had ever noticed a recording barometer sufficiently to borrow an idea from it.

I have a great objection to the use of a *nom de plume*, so I therefore append my name to this.

Fredk. Walker.

36, Spondon Road, Tottenham,
October 4th, 1884.

Telegraph and Telephone Wires in Cities.

I regret that, being in the Antipodes, I could not reply earlier to Mr. Snell's remarks in reference to my design for carrying telephone and telegraph wires through cities; Mr. Snell criticises my proposal, but does not state his objection to it. I do not propose to roof over the footpath, but leave that to the shopkeepers if they think fit; my idea is simply a neat cast iron standard or verandah post, carrying an ornamental frieze, behind which the telephone cables or insulated wires will be supported. I contend this is a solution of the present difficulty of the overhead system until something better can be devised.

Any underground pipes or subways for telephone wires must prove troublesome and expensive, as the pavements must be disturbed for connecting the subscribers; but for through lines to the suburbs and country towns there is no doubt it is practicable. But where is the engineer or lineman who would not prefer having his wires in view, so that faults can be easily and quickly remedied?

I must confess I do not understand Mr. Snell's proposal, and from the drawings it looks more like a trussed girder, with a windlass at each end to tighten up the suspension rods; but I may be mistaken, and would ask Mr. Snell for a little more information on the subject. We want to get rid of the unsightly overhead system, not to multiply it.

We are about to construct one mile of street work, and when completed I will again trouble you with details. Thanking you for your courtesy,

E. C. Cracknell.

Sydney, New South Wales,
August 25th, 1884.

The "Mechanic Receiver."

In reply to the inquiry of "S," contained in your last issue, the disclaimer to Bell's Patent was filed February 13th, 1878. It is numbered A.D. 1876, No. 4765*, that is to say, the same number as the patent with the addition of an asterisk over the right-hand corner. A copy of the disclaimer may be had by forwarding the above number, with the sum of sixpence plus postage, to the Patent Office Sale Branch, 38, Cursitor Street, Chancery Lane, London.

Thos. J. Handford.

42, Southampton Buildings,
October 6th, 1884.

Lightning Protectors for Telegraph Instruments.

With regard to the information asked for on page 268 of your issue of October 4th respecting thunderstorms and telegraph instruments, perhaps an account of my experience in this direction may be of service.

During the last 12 months only five or six cases of coils being fused have come under my notice over the whole of the Great Northern Railway telegraphic system, and these were in signal-repeating instruments, which hitherto it has not been considered necessary to furnish with protectors, one of the wires always being to earth at the signal post.

All the rest of the apparatus, including some thousands of bells, block signalling, and conversing instruments, are provided with twisted wire lightning protectors; and for the last 16 years I have never known a single instance of coils being fused when properly protected in this manner, the protector itself being destroyed instead.

On the other hand, I have known instances where portions of the line wire and platinum contacts of the instruments have been destroyed, and the coils saved. I have, therefore, no hesitation in stating that the simple twisted wire is one of the best lightning protectors known. But to insure success, the wires should be *twisted* and not simply layed together, as is sometimes done, and both wires should be inserted in the circuit.

F. W. Cooke, A.S.T.E. & E.

Telegraph Dept., G.N.R., Retford,
October 6th, 1884.

Telephone Exchanges.

I should feel obliged if you could give me, or tell me where I can procure them, the rules and regulations for starting a telephone exchange, royalties, &c.

Frank W. Davis.

Waterloo House, Malvern,
September 30th, 1884.

[Application should be made to the Secretary of the General Post Office, Private Wire Branch, London.—EDS. ELEC. REV.]

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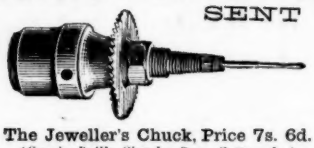

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